ACTA RADIOLOGICA
EDITA PER SOCIETATES RADIOLOGICAS DANIÆ, FENNIÆ, HELVETIÆ, HOLLANDIÆ, NORVEGIÆ ET SUECIÆ

VOL. XI FASC. 6 31 : XII 1930 N:o 64

A FURTHER STUDY OF MASSIVE COLLAPSE OF THE LUNG

By

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(Tabulæ XXXI—LI.)

The investigation into acute massive collapse of the lung, published by us and G. SELANDER in 1929, has since been continued by the present authors.

In our previous work we were mainly dealing with acute collapse after haemoptysis, arisen in connection with or after pneumonia, and after injections of lipiodol into the bronchi.

In the present work we wish to submit, firstly, our further experience of acute pulmonary collapse after haemoptysis as well as after other conditions of the lung and, secondly, also our experiences of pulmonary collapse of a more chronic course arisen in connection with other pulmonary conditions such as bronchostenosis, bronchiectasis, pulmonary tuberculosis without haemoptysis and growths of the lung.

With regard to the literature pertaining to acute pulmonary collapse, to the classification from etiological point of view and how the collapse is produced the reader is referred to our earlier publication.

In the present work our cases have been grouped and disposed as follows:

I. Acute massive collapse of the lung.
   a) in connection with haemoptysis,
   b) in connection with bronchitis.

II. Chronic massive collapse of the lung.
   a) in connection with bronchostenosis, followed by bronchiectasis,
   b) in connection with bronchiectasis,
   c) in connection with pulmonary tuberculosis,
   d) in connection with growths of the lung.

Certain difficulties were met with in the classification particularly regarding II b) collapse of the lung in connection with bronchiectasis, because of the fact that this had first an acute appearance but later persisted unaltered or showed progression, thus taking on a chronic course. Even some of the cases belonging to the other sub-groups of chronic collapse have had, judging from the history, an acute onset but subsequently taken on a chronic course. Regarding the course of the pulmonary collapse in the different cases the reader is referred to the case reports.

I. Acute massive collapse of the lung

a) Massive collapse of the lung arisen in connection with haemoptysis

Since our last publication several cases of acute collapse of the lung after haemoptysis have been published (WILSON, KYLIN, CARL MÜLLER, SAMPSON). These cases have on the whole evidenced the same clinical and roentgenological character as those previously published by us. We are now in the position of publishing still another case.

Case I. R. J., technological student, aged 26 years.

Admitted Sept. 28, 1928.

Was laid up at home for 6 weeks from March 1927 for a right-sided dry pleurisy. Has in other respects been quite well. On Sept. 27 1928 the patient suddenly coughed up about a tea-spoonful of light-coloured frothy blood. In the evening and at night-time the patient continued to cough up blood in quantities which he estimated to altogether more than half-a-litre. Was admitted the following day. General condition slightly impaired. Physical development satisfactory.

Lungs: On superficial examination no definite changes, possibly lagging behind of right lung.

Rtg. ex. Sept. 28, 1928 (Fig. 1). Medial portion of right diaphragm somewhat elevated. Heart and mediastinum slightly displaced to the right. No certain depression of right thorax. Right lung: at the base and medially there is a dense shadow covering the outline of the heart. Laterally in I. 1 and I. 2 there are a couple of ball-shaped opacities in the parenchyma. No changes are seen in the left lung.

On ordinary breathing very small chest movements, yet somewhat less on the right side. Medium dullness over the upper parts of the right lung and marked dullness over the lower and posterior parts. Weakened vesicular breathing over the upper part and markedly so over the lower part. Normal conditions in left lung. Circumference right $47^1/_2$, left 49 cm.

Rtg. ex. Oct. 2 (Fig. 2). Since last examination the diffuse density within the basal parts of the lung-field has much increased both in intensity and extent. This shadow is limited above by a fairly sharp line running from hilus laterally downwards towards the thoracic wall. At the same time the heart has been drawn over towards the right.

Oct. 3. On inspection there are evidently smaller movements on the right side than on the left. Dullness below scapular angle on the right side. Breath-sounds almost inaudible over right base. Bronchophony weakened. Exploratory puncture negative. Trachea in the mid-line.

Oct. 5. On examination to-day it seems as if the dullness on the right side had cleared up a little and the breath-sounds are being better heard. Crepitations over right base. Sputum no tbc.

Rtg. ex. Oct. 5. The basal opacity has cleared up considerably and only remains now at the medial aspect towards the hilum. Displacement of heart is less marked than before.

Numerous Rtg. ex. during the period Oct. 8—Nov. 5 show continued clearing up to complete recovery (Fig. 3).

Commentary. The case agrees well with those previously described of this kind. The history is short, the haemorrhage fairly copious. The collapse in this case is only partial, develops gradually and reaches its climax first on the fourth day. This does not agree with the two first cases but well with the third one in our previous collection as also with WILSON's and MÜLLER's cases.

Besides the 4 cases published of collapse after haemoptysis we have examined the Rtg. picture of still another 21 cases of haemoptysis which were treated at the clinic during the same period of time as the described cases of collapse. This would give one some idea not only of the frequency but also of the conditions causing a collapse after haemoptysis.

With regard to the amount of blood lost we have made up a rough classification, calling those haemorrhages that on superficial estimation do not amount to 100 c.c. small, 100—300 c.c. medium and those above that amount we have called large haemorrhages. Of these 21 cases 14 have on superficial estimation been less than 100 c.c., 5 about 100—300 c.c. and 2 above 300 c.c. Of our cases of collapse 3 haemorrhages belong to the last category and 1 to the first one in which case there was also quite a small partial collapse. Regarding the two cases with large haemorrhages in which no collapse was observed one of them gave a long history with extensive chronic changes, and the other one, it is true, a short history but in this case there were fibrous chronic changes roentgenologically demonstrable. All our cases of collapse presented a short history with acute changes.

It should be noted, however, that in several cases the Rtg. examination was not undertaken immediately after the haemorrhage but several days later. The presence of collapse cannot therefore be entirely excluded even if it is not very probable. In advanced cases we have similarly paid no attention to minor collapses, if present, which we were unable to establish clinically and roentgenologically and which could not be delimited from opacities of other kinds.

b) Massive collapse of the lung in connection with bronchitis

To this group we have referred two cases to be described below.

Case II. A. J., married woman, aged 63 years.

Patient had pneumonia in 1894. Ever since then has been troubled every year with long periods of cough and breathlessness besides fairly copious expectorations. Tbc has not been found.

Since September 1927 patient had had severe cough with breathlessness. On careful examination April 5, 1928 one only found a general hypersonorous percussion note, harsh breath-sounds, numerous rhonchi and at the base fine râles. Heart nil. Blood-pressure 185/110.

Her cough soon got better again and was fairly mild during the summer. In the autumn of 1928 it began again, however, gradually increasing and patient brought up greater quantities of sputum. On Nov. 17 she became suddenly ill, had severe pains in the chest mostly on the left side but also slightly on the right and could only breathe with difficulty. A practitioner consulted sent the pat. to hospital under the diagnosis: left-sided exudative pleurisy plus bronchial asthma.

Condition Nov. 20, 1928. Very bad, thin and pale, marked dyspnoea. Heart displaced to the left. Blood-pressure 105/60.

Right lung hyper-sonorous percussion note, harsh breath-sounds, occasional râles and rhonchi. Left lung: tympanism at the apex, increasing dullness below, wooden note at the base. Breath-sounds weakened over the whole lung, almost inhibited below. Bronchial breathing at the apex, below almost inaudible bronchovesicular breathing. Marked bronchophony in the flank with masses of fine râles. No friction rubs. Abdomen nothing abnormal.

Rtg. ex. Nov. 21 (Fig. 4): Left diaphragm raised. Left half of thorax sunken with more slanting ribs and narrower interspaces than on the right side. Heart and mediastinum much drawn over towards the left. Left lung: massive opacity over the left base gradually fading upwards. Otherwise no opacities in the parenchyma. No changes in right lung.

Sputum: mucupurulent, 50—60 c.c. No elastic fibres. No tbc even in concentration tests.

Dec. 3. Much improved, slight dyspnoea.

Rtg. ex Dec. 12 (Fig. 5). There is a considerable change in the appearance. Diaphragm is no longer raised. The two halves of the thorax are equal. Heart and mediastinum are in the mid-line. The massive dense shadow over the base of the left lung has disappeared.

Discharged Dec. 20, free from symptoms.

Commentary. This case we have regarded as one of acute collapse which has appeared in the form of an independent illness. It is the case of a patient who has suffered from repeated attacks of chronic bronchitis autumn and spring and who is suddenly taken ill with a moderately high temperature, stitches and pains in her left side. On physical examination one finds signs of acute pleurisy with dullness and weakened breath-sounds though with bronchial breathing over the apex. On Rtg. typical collapse. It is worthy of note that the patient all the time had brought up muco-purulent sputa amounting to 50—60 c.c.

It appears in this case as if there had occurred quite a drop in the blood-pressure during the state of lung collapse. The marked dyspnoea is also noteworthy.

Case III. G. I. N., clerk, aged 52 years.

Admitted March 2, 1929. Previously in good health.

Just before Christmas 1928 patient developed a cough, generalized aching pains and felt poorly. Continued his work till after the New Year but had to give it up after a week on account of pains in the back. No temperature. Patient has been in bed since January 10 and his backache has all the time gradually become worse. Patient feels nothing when lying absolutely quiet but on the slightest movement he gets a sharp pain. He also has pains on deep breathing and particularly when coughing. Appetite bad, feels tired and weak.

March 2, 1929 rather bad. On account of his intensive pains it was impossible to make any closer clinical examination of the lungs. Heart, abdomen, urine nil.

There was no distinct tenderness on pressure over the spinal column but on the slightest compression of it in a cranio-caudal direction pat. shows signs of intense pains. Blood-pressure 110/60. WR negative.

Rtg. ex. March 5, 1929 (Fig. 6). Marked narrowing of the whole of the left half of the thorax. Marked displacement to the left of heart and mediastinum. Left diaphragm elevated. Left lung: massive density over the whole pulmonary area; only the air-containing central coarser bronchi can be distinguished. Right lung shows no changes barring emphysema.

Rtg. ex. of spine and pelvis show widespread changes indicating tumorous destructions (? metastasis ? myeloma).

March 18. Marked dullness over the whole left lung; weakened bronchial breathing from the scapular spine to the base, fading away laterally. Fremitus and bronchophony clearly augmented over the whole of the left lung except possibly farthest down in the flank. On exploratory puncture here a few c.c. were obtained of a slightly turbid exudate which on microscopical examination proved to consist of mainly leucocytes, a few lymphocytes and no bacteria. HB 75 %, red blood-corpuscles 2.9 mill., white 7,200, neutrophils 75 %, monocytes 4 %, lymphocytes 21 %. No nucleated red cells.

Rtg. ex. April 3, 1929 (Fig. 7). A considerable change has taken place since last examination. The massive density over the left lung has disappeared. The lung structure can now be well recognised. Slight diffuse opacity over the base of the lung. Left thorax no longer narrowed, nor is there any displacement of heart and mediastinum.

The general condition of the patient became later gradually worse. All the time he had a cough and a fairly copious mucu-purulent sputa but there were no signs of collapse of lung.

Patient died on Dec. 1, 1929 under the clinical diagnosis of myeloma which was also verified at the post-mortem examination.

Commentary. Interest is stimulated here because in a case of myeloma with severe pains in the trunk and simultaneous bronchitis one finds typical collapse of the lung. In the first place one believes a malignant tumour to be the cause. The subsequent course, however, is a complete clearing-up after a few weeks. The painful condition of the patient made it impossible to settle when the lung collapse had begun

and when it had given any typical clinical symptoms. The bronchitis continues during the subsequent course of the illness yet without giving any symptoms of collapse.

There is a certain resemblance between these two cases. In both cases there was chronic bronchitis before as well as after the collapse of the lung. In the first case the lung collapse sets in acutely with severe symptoms, in the second case the patient had very severe pains on account of the myeloma wherefore it was impossible to decide when the collapse set in. The probable cause of the collapse would seemingly be lumps of mucus in the bronchi. In the latter case the patient has also probably subdued the cough and thereby contributed to the accumulation of mucus necessary for the collapse. The mode of production and course in these cases very much remind of the post-operative type of collapse.

II. Chronic massive collapse of the lung

a) Massive collapse of the lung in connection with bronchostenosis followed by bronchiectasis

Of this kind we wish to submit a case of unknown etiology with a slight collapse of lung. The case is of interest because it illustrates the early changes from which the characteristic condition develops to be described in the following groups.

Case IV. S. N., aged 25 years, shop assistant.

Admitted Jan. 14, 1930.

One sister dead in pulmonary tuberculosis. He has completed his conscription service as fit for military duty.

Some time in March or April of last year pat. began to be troubled after a slight cold with attacks of coughing at night. These attacks were of very violent nature, they began with a tickling feeling in the throat, then a dry cough and after strenuous coughing he brought up some sero-purulent mucus. The quantity has varied from a tea-spoonful to a coffee-cupful. Towards the autumn he began to be troubled with breathlessness on the least exertion. Immediately afterwards he often had bouts of coughing. During the last month pat. has become worse, the above mentioned symptoms having become aggravated. No stitch. Has lost 9 kg. in weight during the last year.

Condition Jan. 15, 1930 satisfactory. No cyanosis. On deep breathing piping breath-sounds resembling those found in asthmatic patients. In right axilla there is a non-tender hard gland, nearly the size of a brown bean and in left axilla a similar gland, the size of a hazel-nut. Microscopical examination of one of the glands showed no characteristic changes.

Thorax: Circumference 90—94 cm. Both halves equal. Heart nil. Other organs nil. WR negative. Sputum: slimy, fairly viscous, containing lumps of pus, masses of eosinophil cells. No tbc.

Lungs: Nowhere obvious dullness. Breath-sounds markedly weakened over the whole of the right lung, yet mostly so over the lower lobe. No râles. Increased breathing over the whole of the left lung.

Repeated Rtg. ex. Jan. 16—March 29, 1930 (Fig. 8—11): The anterior part of right diaphragm is clearly elevated. This part of the diaphragm moves very little on breathing while the posterior portion makes big excursions. This part of the diaphragm is not elevated. Heart and mediastinum are obviously displaced towards the right and show considerable oscillations during respiration. On the right side the front-ends of the 5—8 ribs are closer to each other than on the left side. Within the anterior lower part of the right pulmonary field there is a lightly diffuse opacity which becomes more marked towards the middle. In I. 2 there is a ball-shaped opacity in the parenchyma. During expiration can also be seen a clear emphysema in the middle portion of the lung-field.

Jan. 23 (Fig. 12 and 13). Injection of lipiodol, 20 c.c., into right lung. Lower and middle main bronchi are largely filled up with lipiodol. The anterior lower main bronchus is very much narrowed over an area of a few centimeters just after its exit from the lower main bronchus. On the peripheral aspect of this stenosis there are a few smaller ectatic parts of the bronchus. Parenchyma is not filled out at the distal aspect of this. The posterior lower main bronchus shows slight dilatations on the peripheral side of the stenosis. Parenchyma is not filled out. Time of expectoration delayed almost a week.

The condition of the pat. has on the whole been unaltered both as regards general and local changes.

April 2. Induction of pneumothorax: — 22 — 12 : 500 : — 18 — 5.
» 3. — 12 — 8 : 500 : — 9 — 3. April 4. — 15 — 6 : 500 : — 16 — 3.
» 7. — 20 — 7 : 600 : —12 — 2. » 10. — 20 — 3 : 700 : — 10 + 0 etc.

Rtg. ex. April 5—June 10, 1930. Since last examination right-sided pneumothorax has been induced. Upper and lower lobes are moderately collapsed, showing a good amount of air, while the middle lobe is considerably collapsed. A less amount of exudate was gradually added.

Thoracoscopy May 23. All the three pulmonary lobes could be clearly separated from one another. The upper lobe was most easily recognised and contained a fair amount of air. Middle lobe was homogeneously grey and gelatinous without any apparent air-contents. Lower lobe very coarsely nodular with alternately light-grey and dark collapsed parts. Difficult to decide whether the raised parts are air-containing tissue or tumorous infiltrations. On breathing unusually small respiratory movements of the lobe. On the surface solitary small grey-white nodules the character of which cannot be determined.

May 24 discharged for treatment at home. During stay at home improvement of the general condition. No local symptoms.

July 15, 1930 bronchoscopy (Frenckner). Trachea and main bronchi on the whole normal, slight blushing of the mucous membrane on the right. Nothing abnormal at the orifice of the bronchus of the right upper lobe. The orifice of the bronchus of the middle lobe lined with a markedly blushed and swollen, partly granulating mucous membrane causing the lumen to be narrowed to about the size of a knitting needle. A sparing amount of haemorrhagic purulent secretion is exuding from it. Granulations and secretion are collected for microscopical examination. The main bronchus of the right lower lobe is concentrically narrowed to about the size of a slate pencil wherefore it is impossible to pass a bronchoscope and to inspect the bronchial branches. Solid infiltrations are felt in the wall, the mucous membrane is pale, no pathological secretion.

Microscopical examination (Prof. BERGSTRAND). Shows a tissue lined with columnar epithelium studded with inflammatory cells. Within certain areas the columnar epithelium has been transformed into squamous epithelium and small ball-shaped collections of such epithelium can also be seen deeper down in the tissue underneath the columnar epithelium. We are dealing here with a pathological metaplasia. One found no cancerous degeneration of the epithelium. The inflammatory tissue shows no signs of being of tuberculous nature.

During June and July the condition was unchanged. But in August, when the interval between the insufflations was prolonged, the sputum increased and became purulent.

Sept. 12. Bronchoscopical examination (FRENCKNER): The main bronchus of the right lower lobe was filled with secretion; after its removal the main bronchus was dilated and open, while the distal bronchial branches were occluded by inflammatory changes in the mucous membrane. At simultaneous lipiodol-examination the cylindrical bronchiectasis was of a more dilated and sack-like nature.

Commentary. The case now described is a typical case of bronchostenosis where the stenosis, verified both by bronchography and bronchoscopy, is localised above all to the lower main bronchus and to the bronchi belonging of the middle lobe. The stenosis is of circular shape and demonstrable along a distance of several centimeters. It is made up of firm fibrous tissue with no specific character. We have been unable to decide upon its nature. True there is tbc in the history but the way the illness has developed supplies no clue of this or of any other disease. The Rtg. ex. is of special interest. In connection with the stenosis there is local collapse of the anterior basal parts of the lung and expiratory emphysema above the collapsed area indicating a valvular closure in the corresponding bronchus. The pendulum phenomena are also beautifully in evidence. On the other side there is seen opposite the collapsed area a localised slight depression on the thoracic wall, which has not the appearance of a congenital defect. Further, the forepart of the diaphragm opposite the area just mentioned is both elevated and the seat of clearly restricted movements. Both these factors are illustrative of the local effect of the collapse on surrounding tissues and organs. It is further of interest that in this case sack-like bronchiectasis had developed since the last examination. On bronchoscopical examination one could further observe how the ectatic bronchi were open while the distal bronchial branches were occluded by inflammatory process. We will return to this question in the commentary of the collapse in connection with bronchiectasis.

b) Massive collapse of the lung in connection with bronchiectasis

We have not come across any reference in the literature to massive collapse of the lung in connection with bronchiectasis. On the other hand, it is being described especially from patho-anatomical point of view how

in cases of chronic pulmonary collapse bronchiectasis arises in the collapsed part of the lung. HART and MAYER maintain that the development of bronchiectasis is the final stage of a condition of pulmonary collapse. It brings in its train a disposition for inflammatory processes. The alveola are filled up with granulation tissue subsequently leading to cicatricial shrinkage and bronchiectasis. We have found no data regarding changes in the intrathoracic pressure in connection with pulmonary collapse and its effect on the development of bronchiectasis.

In what follows have been described in the first place two cases of bronchiectasis in which a typical massive pulmonary collapse ensued and, secondly, one case in which, judging from the history, a typical pulmomonary collapse first developed and was subsequently followed by bronchiectasis.

The cases are as follows.

Case V. J. E. B., aged 31 years, carpenter. Admitted Dec. 10, 1929.

At the age of 11 left-sided pneumonia. Ever since then been coughing. In 1915 at the age of 18 had again severe left-sided lobar pneumonia; during medical examination in 1916 for life assurance patient was found to have chronic bronchitis. In 1918 influenza. Had severe sharp pains in the left side of the chest. Copious sputa, in bed for about 5 weeks. In 1919 again left-sided pneumonia. In 1920 bronchitis with plenty of sputa, mostly in the mornings, also copious sputa on bending down or lying down. The expectoration was of yellow-green colour, rather thick and of foetid odour. Since then been having colds every spring and autumn with copious sputa which have increased during the last few years. Has generally been coughing up about a coffee-cupful in twenty-four hours. For about the last 10 years been troubled with his heart, yet only on heavy work or brisk walking. Generally worse during the last month. In the night to Dec. 2 1929 suffered from marked breathlessness and palpitation of heart and also had dull pains in the chest. Similar attack on Dec. 9. Condition much impaired. Loss of weight. Marked cyanosis of lips and ears. Watch-glass nails on fingers and toes. Clubbed fingers. Heart: outlines normal, slight presystolic murmur. Lungs: Slight dullness at the base behind on the left side. Breathing normal though weak. Clearly weakened farthest down on the left side. Sputa foetid, purulent, 200—300 c.c. in twenty-four hours. No tbc or elastic fibres. Liver felt $1^1/_2$ finger-breadths below costal arch. Spleen not palpable.

Rtg. ex. Dec. 16, 1929 (Fig. 14). Bilateral chronic bronchitis, bronchiectasis and pleural opacities. Evident emphysema of left lung.

Dec. 28. Pat. complains of pains in his left calf. On palpation can be felt a firm, tender string, thrombophlebitis, on the back of the calf.

Jan. 6. 1930. Sputa increased, entirely purulent. Dyspnoea somewhat increased. Pulse exceedingly rapid, 172/min., small, soft and somewhat irregular. Increasing dullness from scapular spine to the base, marked dullness below scapular angle. Breath-sounds weakened, purely bronchial below angle. Below scapular angle numerous râles of various kinds.

Rtg. ex. Jan. 7. 1930 (Fig. 15). A considerable change has taken place since last examination. Left diaphragm is much elevated and left thorax narrowed. Heart and mediastinum displaced towards the left. Massive collapse of the lower part of the left lung.

Jan. 9. On inspection left half of thorax is seen on inspiration to be clearly flattened and partakes in respiration much less than the right side; costal interspaces on left side clearly deeper than on the right. Trachea drawn over to the left. Hypersonorous percussion note on right side. Heart: dullness begins just to the left of the sternal border.

Circumference of right half of thorax on expiration							41.5	cm.
»	» left	»	»	»	»	»	40.0	»
»	» right	»	»	»	»	inspiration	43.0	»
»	» left	»	»	»	»	»	41.0	»

Rtg. ex. Jan. 10. Collapse of same extent as before. Lipiodol injection, 15 c.c., into left side (Fig. 16 and 17) shows the posterior branches of left lower main bronchus to be filled out. These branches show saccular dilatations of medium size. On the other hand can no filling be seen of the anterior branches of the lower main bronchus. The collapse is above all well marked within the anterior portion of the lower lobe, apparent on oblique pictures.

Jan. 11. Pat. was placed on his right side slightly on the slant forwards downwards; he then coughed up great quantities of very foetid sputa containing lipiodol. After the foot-end had been raised and pat. rested for a while he still expectorated sputa containing much lipiodol. Lungs were then again examined with the following result: Scarcely medium dullness over parts over which there had previously been marked dullness. Breathing vesicobronchial, the pure bronchial breathing has quite disappeared. Râles very scanty. After the expectoration pat. said he could breathe more easily than before. Rtg. ex. (Fig. 18) also showed the collapse clearing up with diminished displacement.

Rtg. ex. Feb. 6. Lipiodol injection into right side. Right lower and middle main bronchi filled out. They are the seat of small cylindrical dilatations. The collapse within the left lung remains unaltered.

Rtg. ex. March 15 and 19 (Fig. 19). Since last examination the massive collapse within the left lung has again increased both in extent and intensity; there is now a massive density over the whole of the left lung area. Displacement of heart and mediastinum is more marked than before as is also the narrowing of thorax and elevation of the diaphragm. On lipiodol injection of the left lung (Fig. 20 and 21) the lower posterior main bronchi were seen to fill out; they were much more dilated than on previous examination. The individual bronchial dilatations are closer to one another.

During the time passed the condition of the pat. has become slowly worse but no new symptoms had been added. The pat.'s condition being too bad for thoracoplasty pneumothorax was induced on April 3.

Pressure:	3/4	—	40	—	14	:	500	:	—	14 — 8
	4/4	—	32	—	13	:	400	:	—	10 ± 0
	5/4	—	19	—	9	:	470	:	—	1 + 3
	8/4	—	20	—	3	:	450	:	±	0 + 4

Rtg. ex. April 23. Since last examination pneumothorax on the left side. Lower lobe mostly collapsed. Upper lobe is adherent to the thoracic wall laterally as well as upwards. Smaller cavities seem to persist in it. Heart and trachea are still displaced to the left. Right lung as before.

During the pneumothorax treatment the general condition seemed clearly to improve and the sputa diminished in amount for a few weeks. In the middle of May the condition again became aggravated.

May 20. Marked cyanosis, moderate dyspnoea, anorexia, vomiting. To-day pat. coughed up a light-coloured frothy blood about 20 c.c.

May 22. General condition much impaired last few days. Marked dyspnoea and cyanosis. Sputa copious, fairly much admixed with light-frothy blood.

May 22. Patient died.

Case VI. K. J. H., farmer, aged 46 years.

Admitted June 6, 1930.

No heredity or exposure to tbc. In good health during adolescence. Present illness dates back to 1911. Pat. had repeated colds, always felt tired and weak and was coughing a great deal. Has not been in hospital. Pat. was very much better during the following year and has since then for many consecutive years felt relatively well and been able to do his work. In the spring of 1929, however, his condition became worse. A cold of brief duration was followed by marked fatigue and want of strength. Pat. became readily short of breath and ran a temperature now and then with night sweats. Since then the coughing has gradually increased. Has had fairly copious sputa sometimes admixed with streaks of blood. Temporary improvement during the summer but since the last autumn and winter the condition has again been the same. Has consulted doctors who have regarded his condition as one of pulmonary tuberculosis with chronic bronchitis. His working capacity has lately been considerably impaired.

Condition June 6, 1930 fairly satisfactory. Flesh plentiful. Muscular development satisfactory. Heart nil. Abdomen nil. Thorax: right shoulder somewhat lower. Small excursions on respiration. Left-sided convex dorsal scoliosis. No difference in the circumference of the two halves of the chest, 52 cm. On examination of the lungs marked changes are found over the right lung mostly reminding of a chronic pulmonary tbc, thus marked dullness over the apex gradually diminishing below, so that over the lower half of the lung there is only slight dullness. There is no real difference in front and behind. Normal percussion note over the left lung. On auscultation marked bronchoamphoric breathing over the right apex, gradually assuming normal character, over the lower half breathing clearly weakened. Râles of all sizes over the apex, gradually diminishing in number and size towards the base. Rhonchi are heard over the left lung, beyond that no changes here.

Rtg. ex. June 7, 1930 (Fig. 22). Marked dorsal scoliosis with the convexity to the left. Narrowing of the whole of the right half of thorax. Heart and mediastinum drawn over to the right. Diaphragm higher on the right side than on the left. Sinus adherent. Right lung: massive density in the hilum. Within the lung there is seen an infiltrated tissue with a number of cavities of larger or smaller size right from the apex to the VII rib in front. Left lung shows a slight central opacity, the central bronchi somewhat dilated.

June 8. Sputum purulent and foetid with a couple of blood-streaks and a sparing amount of elastic fibres. No tbc bacteria on numerous tests, including concentration tests. WR neg. Kahn neg. While in hospital was running a temperature varying between 38° and 39° besides copious foetid sputa. No subjective improvement was observed.

On examination on June 20 one found on the whole the same changes in the lungs although with this difference that the dullness over the lower parts was now of medium strength and the breath-sounds still weaker.

Rtg. ex. June 21 (Fig. 23). Since last examination a considerable change has set in. There is now a massive opacity over the whole pulmonary area most marked

at the base. The cavities can still be seen in the upper parts. Heart and mediastinum are now displaced still further towards the right.

Bronchoscopy June 27, 1930 (FRENCKNER). Tracheal mucous membrane blushed. Width of carina increased, redness, swollen. Right main bronchus filled with a purulent secretion, its mucous membrane is very red and swollen; on the medial wall just below carina the mucous membrane has an uneven and nodular appearance. When the secretion has been aspirated the main bronchus to the lower lobe is seen to end blindly, the orifices of the bronchial branches only appear as dark shadows, completely closed by an intensively swollen mucous membrane. The bronchial branches are entered by means of a fine aspiration canula and when a copious amount of secretion has been aspirated their lumina are found to stand open.

July 1. The general condition during the last few days possibly somewhat improved. Plenty of foetid purulent sputum.

On examination on July 1. the amphoric character of the bronchial breathing over the apex is found to be more marked as also the basal dullness. Similarly was the bronchial breathing over the lower parts of the lung found to be more marked both as regards character and strength.

Bronchoscopy July 10, 1930 (FRENCKNER). Much less secretion than the last time. The bronchial branches of the lower lobe are now completely closed by a swollen mucous membrane, their lumina do not open quite as much now after aspiration. The mucous membrane over the eroded spot near the carina is now swollen in a tumorous fashion and seemingly wrinkled, it seems everywhere to have a normal epithelial lining. Beyond this the findings were the same as the last time.

Rtg. ex. after the aspirations performed at the bronchoscopy showed no change in the collapse. After the first bronchoscopical examination improvement obtained in the general condition with reduction of the temperature and diminished sputa. After the second examination, on the other hand, the temperature rose a little and sputa increased in amount.

On account of the patient refusing thoracoplasty pneumothorax treatment was attempted on July 7. Only a small shut-off room was obtained. Pressure —40 —36 cm. H_2O. After 40 c.c. of air positive pressure was obtained. After still further attempts at insufflation with just as little success the treatment was given up.

Case VII. S. A. N., cashier, aged 31 years.

Had not been exposed to tbc. Severely ill with influenza in 1918. Otherwise always well. During the last 4—5 years has easily been catching colds accompanied by coughing for short periods.

After having felt a little tired a week before with slight shivers, breathlessness on climbing stairs and occasional sharp pains below the right costal arch besides a slight cough her present illness began acutely on April 4 1930 with slight shivering. Been in bed at home since April 5. Temperature was at first 38°.5—39°.5, latterly 37°.6—38°.5. Called in a doctor on April 10 who considered it was a case of pleuritic exudation of the right side. No puncture.

Condition April 11, 1930 satisfactory. Bodily constitution and coverings ordinary. Slight stitch on the right side. Mild cyanosis. A little dyspnoea on movements. Heart somewhat displaced towards the right. Otherwise nil No club-fingers.

Chest: marked depression of the right half of the thorax. Infraclavicular

fossa markedly hollowed. Right lung: well marked dullness, bronchial breathing slightly weakened below scapular angle and C. 3, plenty of râles. Bronchial breathing heard in the interscapular space of the left lung, besides that nothing definite.

Sputum strongly purulent, tbc-bacilli present. SR 98 mm/1 hr. WR neg. Kahn neg. Exploratory puncture into right pleura: neg., the needle passes very thick and fibrous tissue.

Rtg. ex. April 14, 1930 (Fig. 24). Well marked sinking of the right half of the thorax which shows more slanting ribs and narrower interspaces than on the left side. Heart and mediastinum altogether displaced to the right, the cardiac apex lying opposite the spine. Massive density over the whole lung. No bronchial lumina visible. Left lung shows no change besides emphysema.

April 16. Heart much displaced to right, left border at the left sternal margin. Lungs on the whole as before. S. R. 103 mm/1 hr.

April 20. Right lung: well marked bronchoamphoric breathing, not weakened.

May 2. Right lung makes very small excursions on respiration. Very well marked bronchoamphoric breathing over the whole of the right lung right down to the base and numerous medium-sized dry râles after coughing. Left lung as before.

May 5. Intracutaneous injection of Altuberculin, 0.1 mg. After 24 hours local erythema, 15 × 20 mm. After 48 hours very marked reaction w th erythema measuring 35 × 25 mm. and an inner vesicular zone measuring 10 × 10 mm.

May 11. Condition unchanged except in the following respects: Thorax feels stiffer on the right than on the left side. Circumference of right half of chest 41 cm., left half 46 cm. Well audible heart-sounds all over the right side. Blood-pressure: 110/75. Abdomen nil.

Rtg. ex. May 12, 1930 (Fig. 25). This skiagram is far better defined, large bronchiectatic dilatations being visible in the collapsed lung. Otherwise no changes.

Rtg. ex. May 13 (Fig. 26): After injection of lipiodol, 20 c.c., into the right main bronchus, the bronchial dilatations just mentioned can be seen filled out. Only smaller quantities of lipiodol extend down towards the base. No lipiodol in front. The filled out bronchi are for the most part situated centrally. Time of expectoration much prolonged, about 4 days.

After the lipiodol injection sputa increased considerably in amount, to about 200—300 c.c., and the temperature rose for about a fortnight, subsequently again falling.

Sputum examined several times, including concentration test, no tbc bacilli were found, masses of long chains of streptococci, no elastic fibres.

Rtg. ex. May 21 (Fig. 27). A large cavity observed centrally. At the bottom of this a horisontal fluid outline with some lipiodol remnants.

May 24. Bronchoamphoric breathing still marked, other changes the same.

June 4. Transferred to surgical department for thoracoplasty which was carried out in two stages.

July 19. The post-operative course has been excellent and at present the pat. is running no temperature; sputa 10—15 c.c.

Commentary. In critically examining these three cases of pulmonary collapse with bronchiectasis it should be stated at the outset that they all present the clinical and roentgenological changes with which we are acquainted in post-operative collapse as well as in collapse after haemoptysis. The diagnosis would therefore seem quite certain. The fact that

we in so short a time and among such a limited number of cases have met with no less than three cases will be subject to discussion later on.

Of these cases the two first make up a group by themselves. It is a question here of chronic bronchiectasis with typical histories of many years' run and where the collapse presents itself as a complication to the original disease. The conditions are reversed in the third case. Here the patient evidently first develops an acute collapse of the lung and in connection therewith extensive bronchiectasis ensues.

Returning to the two first cases the first of them is of particular interest. As already mentioned the case presenting itself to us is a patient who had suffered from his troubles for many years and whose condition on admission was much impaired with a typical clinical picture of chronic bronchiectasis most marked on the left side. Soon after admission the patient is taken ill with thrombophlebitis in the leg with the result that he has to remain still in bed. This again rendered the expectoration difficult and without any further appreciable symptoms being added one found on ordinary physical examination dullness over the middle and lower parts of the left lung besides well-marked bronchoamphoric breathing and a depression of the same side. The Rtg.ex. confirmed the presence of typical collapse of the left lung with all its signs and symptoms.

Our view of the case was that the difficult emptying of the bronchiectatic parts of the lung had occasioned a purely mechanical occlusion of the bronchi through sputa, as happens in cases of post-operative collapse. As suggested by SANTE we tried by placing the patient in prone position to empty the bronchi as completely as possible and thereby get the collapse to clear up. As evidenced both by physical and Rtg.ex. this was partly successful. It became obvious that by this simple manner the lung became more aerated and the signs of displacement less marked. This improvement, however, was only noticed at the beginning and to a certain extent. Later on the collapse became worse in spite of energetic treatment of that nature. It is clear, therefore, that the collapse could not merely be due to mechanical occlusion of the bronchi by mucous lumps. One also found the bronchial dilatations getting bigger and extending higher up. This was evident by physical examination but above all by Rtg. ex. At the lipiodol examination — although it is impossible to say here whether exactly the same bronchi are filled out — the difference in appearance and size of the bronchial dilatations was exceedingly striking. In our minds therefore, there is no doubt that during the progress of the collapse there had also occurred an aggravation of the bronchiectatic condition.

As the patient was too bad for thoracoplastic operation an attempt was made with induction of pneumothorax. Only partial pneumothorax

was obtained with short-lived improvement and after an attack of haemoptysis the patient succumbed.

The second case is similar to the first one. There is a long history and on admission changes are found which mostly resemble a chronic tbc with subsequent bronchiectasis. Yet no tbc bacteria were ever found. On the first Rtg. ex. one finds a density in the pulmonary hilum but nothing that points to a condition of massive collapse. Without having found any particular alteration in the clinical picture barring increased temperature and sputa the Rtg. ex. a fortnight later shows a considerable change in the appearance, this being now one of typical pulmonary collapse with the same clinical and roentgenological signs as in the last case.

Bronchoscopic examination was also carried out in this case which afforded the valuable information that the larger bronchi of the lower lobe remained patent while their bronchial branches were quite closed on account of the inflammatory mucous membrane. Attempts to clear up the collapse by aspiration of sputa or even mechanical opening by probing the bronchial branches had not the desired result. Nor did change of position after SANTE bring about any improvement. While in hospital it was impossible in this case roentgenologically to find any definite enlargement of the bronchial dilatations but clinically there was an obvious aggravation of the condition. The bronchoamphoric breathing became more marked while the pat. was in hospital. The temperature rose, the sputa became more and more foetid and increased in amount up to 400—500 c.c. in the twenty-four hours.

The third case differs, as already mentioned, in an important respect from the two previous ones. There is only quite a short history in this case. The patient is able to fix the onset of illness almost to the day. Judging from the history one then thought of an acute illness with acute collapse of lung as an independent condition. No fluid was obtained on puncture, the needle was felt to pass through fibrous tissue, probably a thickened pleura. Whether a lung indurated through collapse may give the same resistant feeling is not easy to say but would scarcely seem likely. It is further of the greatest importance to note that no bronchiectasis was seen on the first Rtg. ex. The subsequent course is exceedingly remarkable. On physical as well as above all Rtg. ex. one found bronchial dilatations which seemed to increase rapidly during the patient's stay in hospital. At the same time the patient was running a temperature and was bringing up considerably more purulent sputa. The symptoms became worse particularly after the lipiodol examination and on our examination we were able to show a rapid enlargement of the cavitations. It is rather difficult to make out what pathological process is the cause of the condition. At first one found on examination of the sputum acid-fast bacilli which quite naturally were regarded as tbc-bacilli. In spite of the

most careful examination by all available methods we have been unable to rediscover them. In our opinion tbc is not likely to have been present but rather acid-fast bacilli of some other kind or else was there some technical error.

We have arrived at the conclusion, therefore, that it has been a question of bronchial dilatations which have rapidly become enlarged. The Rtg. appearance is also in favour of this assumption and is not similar that of one or several abscesses. Yet it is difficult to draw the line here. One often finds smaller local abscess formations in cases of bronchiectasis. For the development of bronchiectasis we feel inclined to attach great importance to the collapse. This does not imply that the bronchial dilatations might not have been present in a slight degree before the onset of collapse.

These three cases of pulmonary collapse and bronchiectasis are of interest from several points of view.

In the two first cases the massive collapse sets in preceded by bronchiectasis without symptoms and only accompanied by increase of the purulent sputa and rise of temperature. On physical examination the picture was most like one of bronchopneumonia with fairly marked dullness and well audible bronchoamphoric breathing. In the third case the breathing was at first of a weakened bronchial nature but later during the development of the bronchiectasis of more and more bronchoamphoric character. There is no doubt in our opinion that on physical examination of these severely ill patients one should have regarded their condition as one of bronchopneumonia. In case of chronic bronchiectasis of many years' standing such conditions are probably not uncommon. It is only in exceptional cases that they are subjected to Rtg. ex. and their true nature thereby revealed. This might explain why we in such a short time have managed to collect no less than three cases. These cases also seem to show that bronchopneumonia and pulmonary collapse are closely allied conditions, as has been pointed out by CORYLLOS, LEE and TUCKER. A closer investigation into this question, however, can only be done through patho-anatomical examinations.

The character of the breath-sounds over the collapsed areas was, as already mentioned, well audible bronchoamphoric with increased augmented bronchophony and fremitus, contrary to all the previous cases where the main type was weakened breath-sounds and reduced bronchophony and fremitus. The latter condition is also that generally occurring, judging from the literature. CHEVALIER JACKSON and LEE, however, describe both these types of breathing and explain the latter type as »probably dependent upon the patency of the bronchi. When there is a large proportion of air in them, there is an increase in the breath-sounds and they may be loud tubular or amphoric in character and bron-

chophony and pectoroloquy may be present». The authors submit no other or closer data as to the explanation of this difference. We have also coupled the different character of the breath-sounds with the condition of the bronchi. In those cases in which the bronchi are entirely occluded as in haemoptysis or in the cases of post-operative pulmonary collapse the breathing is much weakened. This was also the case with case VII on admission to hospital. Already then, however, bronchial breathing was present. During the following weeks the breathing assumed a more and more bronchoamphoric character at the same time as the bronchial dilatations became larger. We have therefore arrived at the conclusion that the presence of bronchoamphoric breath-sounds in cases of pulmonary collapse means that bronchiectasis has developed or been present before, the dilated bronchi standing as open channels in the collapsed part of the lung. The above explanation of the character of the breath-sounds only applies to cases of bronchiectasis. As will be described later we have found a similar breathing in cases of collapse in connection with tumour of the lung of which we have been unable to give any sure explanation.

This leads us on to the question of the pathology and genesis of bronchiectasis, as the cases under review would seem to furnish us with a few fresh clues.

According to BRAUER acquired bronchiectasis can be divided into three groups.

A. Primary bronchiectasis arising from bronchi of large to medium size. Besides primary bronchitis and its chronic forms other causes may be: foreign bodies, luetic processes or else such conditions productive of bronchial stenosis.

B. The second most common group of bronchiectasis develops from primary bronchiolitis and associated broncho-pneumonia, especially often in association with measles, influenza and pertussis. The peribronchial lymphangitis, the pathogenetic importance for the human pathology of which we have still insufficient knowledge but well so for the animal pathology, plays a decisive rôle.

C. A third group is made up of cases of pleurogenous bronchiectasis. After pleurisy with adhesions bronchiectasis is supposed to arise secondarily. According to BRAUER this last group is of least importance because the pleuritic changes are often of secondary nature and in the early stages of bronchiectasis in childhood the pleura is generally free.

In the same paper BRAUER is raising the question: »Why does bronchiectasis develop in the conditions described under B.?» Numerous factors probably play their part here. Dilatation of the bronchi is conditioned by an inflammatory process with consequent loss of elasticity, the bronchi so altered are then subjected to traction from without. Such traction is to some extent already present under normal physiological

conditions, being effected by the normal elasticity of lung tissue and further by the inspiratory stretching of the lung; secondly traction is also present under pathological conditions such as shrinkage through cicatrization. This latter factor probably plays a great part. In chronic interstitial processes of all kinds a shrinking process takes place after some time which tends to dilate the bronchi located in the fibrous lung tissue. This is also emphasized by KOWITZ who is supported in his view by TENDELOO. In summary BRAUER states as follows: »Die mechanischen Ursachen der Ectasie bestehen somit in dem Elasticitetsverluste einerseits und in den von aussen auf die Bronchien einwirkenden Zugkräften anderseits».

A third view maintains that the intrabronchial pressure would play some part in dilating the bronchi as also accumulation of secretion and the positive pressure arisen through bouts of coughing. BRAUER only attaches slight importance to all these factors.

A third question advanced by BRAUER is this: »How is it that the conditions once begun has such a marked tendency to progression?» The cause of this is to be found in the anatomical changes with their tendency to causing shrinkage, in attacks of bronchopneumonia and finally in a disturbed function of the dilated bronchi as a result of the aggravated discharge of their contents.

It will be clear from this summary account that from clinical point of view no statement is made concerning the pulmonary collapse and its importance for the production of ectasis. In consulting patho-anatomical abstracts such as by LOESCHKE in HENKE and LUBARSCH's hand-book, one will find, it is true, a powerful plea for the importance of atelectasis for the production of bronchiectasis particularly in the atelectatic regions but nowhere is it stated *how* the condition actually arises.

It may be of interest therefore to consider the production of collapse of lung in view of the information afforded by these cases of ours. In the first place we would point out that BRAUER has emphasized several factors to which some importance can and should be attached for the development of bronchiectasis. In our opinion, however, pulmonary collapse should not be forgotten. In every collapse of lung, partial or complete, there arises an increased negative pressure in the pleural cavity even up to 4—5 times the normal, and it seems to us quite out of the question that such a pressure would not influence the lung and bronchi. In the two cases of bronchiectasis in which we had the opportunity of measuring the negative pressure, it amounted to — 30, — 40 cm. H_2O. This negative pressure is produced by the collapse of larger or smaller parts of the lung whereby a reduction of the volume takes place. The negative pressure cannot be higher than that in the collapsed and closed areas. On the other hand a considerable difference in pressure occurs between this high negative pressure in the pleural cavity and the pressure in the open bronchi

and alveoli and also cavities, if present, a difference which must result in dilatation of these bronchi and alveoli. It will be clear, therefore, that we must ascribe great importance to the high negative pressure in cases of lung collapse for the production of bronchiectasis. This high negative pressure must affect not only the open bronchi patent in the collapsed parts of the lung but also those in the healthy parts of the lung; on account of the infection, however, present in certain bronchi with consequent weakening of the walls, these are the first to become dilated. In this connection mention should be made of CUTLER's experiments on animals with the view of producing lung abscesses. He was only successful in doing this if he at the same time produced collapse in some part of the lung, a piece of evidence, therefore, in favour of its importance also in this respect.

Still another factor merits discussion. The view generally held is that in cases of more extensive collapse of lung it is above all the stenosis and the occlusion of the larger bronchi that give rise to the collapse. This is above all clear from statements made by American authors. But evidently quite the same appearance can be obtained clinically and roentgenologically if the large bronchi are intact but the branches of these are extensively occluded. The question is whether the latter condition is not the case in bronchiectasis. Certain observations are in favour of this.

1) Patho-anatomically it has been found that on examination of cases of cylindrical bronchiectasis the peripheral branches of these dilatations are most often occluded (HART and MAYER).

2) On lipiodol injection into ectatic bronchi one never finds any lipiodol in surrounding parenchyma or on the peripheral aspect of the dilated bronchi. Moreover these often appear to be located in air-less tissue.

3) On bronchoscopy in case IV and VI the branches of the larger inflamed bronchi were found to be quite matted together by the inflammatory state of the mucous membrane. True that we are dealing here with two cases only from which no generalised conclusions can be drawn but together with the reasons put forth in 1 and 2 we would venture to advance still another hypothetical cause of the development of bronchiectasis.

In conjunction with bronchitis and swelling of the mucous membrane we get occlusion of the lumen of the neighbouring bronchial branches. This results in collapse of their alveoli and bronchioles. On this collapse becoming sufficiently marked, the negative pressure in the pleural cavity will become raised. This will tend to aggravate the bronchial dilatations and we thus get an interaction between local collapse and an increased dilatation of the ectatic bronchi. In the case of smaller collapse a local suction on neighbouring tissue may conceivably take place with the same effect as a traction by scar tissue. This interaction seems to be present

in all these three cases and it would seem as if this phenomenon could quite well be applied in cases of bronchiectasis in general. This will then also satisfactorily explain the well-known tendency of the disease for periodicity and progressiveness.

c) Massive collapse of the lung in connection with tuberculosis

Massive collapse in cases of pulmonary tuberculosis has been dealt with exceedingly sparingly in the literature. True enough one often finds smaller atelectatic parts mentioned in descriptions of Rtg. pictures and such will also be found mentioned in the literature in connection with pulmonary tuberculosis, but only in solitary cases has the massive collapse of the same kind as the post-operative collapse or that occurring after haemoptysis been subject to clinical and roentgenological elaboration. Still less has its importance for the tuberculous process in the lung been discussed. We have found in the literature that PACKARD has described three cases of chronic pulmonary tuberculosis, in which there was a clinical picture of lung collapse, and in addition a case combined with cancer of the lung.

The first case was that of chronic fibrous pulmonary tuberculosis where the patient at a certain point of time became short of breath and got a stitch in the affected side. On Rtg. ex. one found the appearance of massive collapse of the lung. After a few days the above symptoms ceased. Two years later the patient died of acute pulmonary tuberculosis of the previously healthy lung. On autopsy there was a markedly shrunken and carnificated left lung with numerous adhesions. The left main bronchus was practically obliterated by surrounding fibrous tissue.

In the second case there was similarly chronic pulmonary tuberculosis in the upper part of the left lung. There is no mention of any acute onset of symptoms from the lungs. In connection with an acute attack of gastro-enteritis the patient developed slight symptoms from the left lung of the same nature as in the previous case. On Rtg. ex. was found the ordinary appearance of a pulmonary collapse. It is of great interest that in the upper part of the lung there was a large cavity of exactly the same type as in one of our cases to be described below. The collapse has disappeared and the cavity can after a few years no longer be seen; it has probably healed.

In the third case there was a question of a central tbc in which similar symptoms suddenly set in. The Rtg. ex. showed the picture of massive collapse. Pneumothorax was induced in this case, the high negative pressure of — 23 — 8:100 c.c.: — 23 — 3 being found. The cause of the collapse is not known but is assumed to be enlarged lympathic glands in the hilum compressing the main bronchus.

In PACKARD's work we have found reference being made to FARRIS. This author has also published cases of massive collapse in cases of pulmonary tuberculosis. We have only had the opportunity, however, of seeing an abstract of his work. In one case there was obliteration of a main bronchus on account of caseous masses in the surroundings, in another case there were enlarged tracheo-bronchial glands. FARRIS as well as PACKARD find the symptoms in pulmonary collapse relatively mild and the prognosis relatively good.

SPROULL described a case in detail. A girl, aged 24, had had mild respiratory symptoms for eight months and being worse for the last month. She then had a slight attack of haemoptysis, a feeling of oppression but no pains. Clinical as well as Rtg. ex. showed typical collapse of the lower half of the right lung which subsequently increased in extent invading also the upper lobe. On bronchoscopy the right main bronchus was found to be thickened and flattened out, probably as a result of infiltration from without in addition to some swelling of the bronchial mucous membrane. The author relates in brief two further cases with similar Rtg. appearances.

HABBLISTON also describes a case with an atypical history in a case of old pulmonary tuberculosis. Lately progressive dyspnoea was gradually added and on examination one found the usual signs of massive collapse.

The above is what we have found in the special literature on the subject of pulmonary collapse. Many of the cases described in the literature as fibrotic lungs are probably sequences of massive collapse. It seems to us that the importance of the latter has not been sufficiently realised.

Below will follow a description of our cases.

Case VIII. D. T., spinster, aged 23 years.

Admitted Sept. 7, 1929.

No disposition for tbc. Pat. has been of weak health ever since childhood. Has often been coughing, sparing amount of expectoration.

Present illness began in April of this year when patient felt more tired and weak than usual. Was in bed from the middle of June for three weeks with a temperature of 38°.8—39°.8 C. Had a cough, particularly in the mornings. Never coughed up any blood. In July she had sharp pains in the left side of temporary nature. Her doctor suspected pleurisy.

Condition Sept. 7, 1929. Flesh much reduced and lax. Muscles atrophied. No watch-glass nails. Slight dyspnoea. No cyanosis.

Thorax asthenic. Slight dorsal kyphosis. Left half of thorax moving much less than the right. Scoliosis of the lower dorsal region with the convexity to the left. Marked dullness over left side with tympanitic note as far as the scapular angle, then slightly clearing up. Marked dullness of supra- and infraclavicular fossae, clearing up a little from I. 2 downwards. Much weakened bronchial breath-sounds from above and down to the middle. From there more vesicobronchial in nature. Over the whole of the left lung fairly numerous small to medium-sized harsh râles, moderate amount of friction sounds.

Right side: Moderate dullness in supraclavicular and supraspinous fossae. Weakened vesicobronchial breath-sounds. Heart nil, abdomen nil, urine nil. Sputum purulent, tbc bacilli present.

Rtg. ex. Sept. 9, 1929 (Fig. 28 and 29). Left diaphragm is elevated and moves scarcely at all on respiration. The whole of the left half of the chest is narrowed with ribs more slanting and the interspaces narrower than on the right side. Heart and mediastinum are much displaced towards the left. This displacement is more marked on inspiration than on expiration (respiratory pendulum). Massive opacity over the whole left lung completely obscuring all lung structure. Within the upper part of it can be seen a few rounded small areas of rarefaction. Mild opacity in the right hilum covering the vascular structure there.

Sept. 16. Induction of pneumothorax, pressure —34 —28 : 500 c.c. —12 —6. Sept. 18. —18 —8 : 400 c.c. —6 —1. The pneumothorax insufflations were then continued without difficulty.

Rtg. ex. Sept. 16. Left-sided pneumothorax surrounding the collapsed lung in a cloak-like manner Small amount of fluid in pleural sinus. Thin adhesions from parietal pleura to the upper lobe.

Further Rtg. ex. showed complete collapse of lung, the exudate disappeared and finally one got displacement of heart and mediastinum to the right.

Case IX. E.R., married woman, aged 27 years.

Admitted Sept. 16, 1930.

Mother and one brother died of pulmonary tuberculosis.

In July 1925 right-sided pneumonia for which pat. was treated at home for 1 month; complete recovery. Present illness began in April 1930 when pat. was taken acutely ill without any previous warning with a temp. of 37°—38°, dry cough and sharp pains in the left side of the chest on deep breathing. Pat. felt weak and tired and was troubled with night-sweats. After 1—2 weeks pat. consulted a doctor who found tbc-changes in the left lung; pat. was then admitted to hospital at the end of May for further examination. During her subsequent stay at home in the summer she was mostly in bed. Temp. 37°—38°. Has been coughing up about a $^1/_4$ coffee-cupful of yellow-green but never blood-stained sputa per day.

During last few weeks general aggravation of condition with vomiting etc. Temp. 38°—38°.8. Increased cough and huskiness of voice.

Condition Sept. 16 much impaired. Marked dyspnoea which increases on the least exertion. Generalised pallor of skin, marked cyanosis. Flesh ordinary but loose. Finger-nails cyanotic and watch-glass-shaped. Heart nil. No deformity of thorax. Left half of thorax somewhat behind in the movements. Circumference 83 cm., l. half 40, r. half 43 cm. Marked dullness over the whole of the left lung, a little less over the basal parts. Pronounced bronchial breathing over the upper half with amphoric character over the apex. Lower half broncho-vesicular breathing. Over upper half râles of all sizes. Right lung nil. Sputum 40—50 c.c., mucupurulent, tbc +++.

Sept. 17, 1930. Rtg. ex. Left half of thorax much depressed with more slanting ribs and narrower interspaces than on the right side. Heart and mediastinum displaced towards the right. Left diaphragm somewhat raised and moving less on respiration than the right. A massive opacity over the left lung area except basally. Cavernous system within the upper part of the lung-area.

Sept. 18. Induction of pneumothorax. —23 —20; 500; —14 —3.
Sept. 19. —14 — 4; 400; — 6 —2.
» 20. — 9 ± 0; 400; + 1 +4.

Sept. 29. Rtg. ex. Left-sided pneumothorax. Lung well collapsed. From the apex a couple of thin adhesions towards the chest-wall. Beyond this the lung is quite free. Less amount of exudate filling out the sinus. Heart and mediastinum somewhat displaced to the right.

The temperature which on admission had kept at about 39° gradually fell, being very nearly normal one week after the induction of pneumothorax. Considerable improvement of the general condition. The marked dyspnoea present on admission is similarly much reduced.

Case X. R. B. spinster, aged 23 years.

Admitted Sept. 25, 1929.

No tbc in family or immediate surroundings. Present illness commenced in November 1927. Pat. went about with a cold and a temperature, was tired and weak and had a cough and sharp pain in the right side. After 3 weeks her doctor considered the case being one of exudative pleurisy on the right side. Pat. was in bed for 8 weeks at home. No puncture. After that she was in a hospital for 10 weeks from Jan. 2, 1928.

Condition fairly satisfactory. Right lung: percussion note not quite clear at apex. Increasing dullness at the base of the scapular spine and of I.2, dull as wood at the base. Over about the upper half mixed breath-sounds with occasional râles of medium hardness. Below that weakened to nil breath-sounds with plenty of subcrepitating and somewhat louder râles. Friction rubs in front. Exploratory puncture negative.

Rtg. ex. Jan. 5, 1928 (Fig. 32): Lower part of right thorax slightly lowered with more slanting ribs and narrower interspaces than on the left side. Heart and mediastinum displaced to the right. Right diaphragm elevated. Over the basal parts of right lung a diffuse opacity fading away upwards. Above this a widespread mottled density in the parenchyma. Behind the clavicle a cavity of smaller size of a diameter of 1.2 cm. besides a couple of smaller cavities within the apical region. No changes in the left lung.

March 15, 1928. Scarcely any wooden percussion note. Around angulus and below bronchial breathing partly of amphoric character. Râles rather less. No friction rubs. Subsequently spent her time at home, felt quite well although easily catching colds and often went about with a temperature. On renewed examination in hospital on Oct. 8, 1928 Rtg. ex. showed as follows (Fig. 33): The lowering of the right half thorax is more marked than before, as also the displacement of heart and mediastinum. The massive density at the base has increased. The cavity in the apical area has increased considerably in size. It measures 3.5 cm. in diameter. It is very thin-walled with slight reaction in the surroundings. No changes in the left lung.

Was admitted to sanatorium in Feb. 1929 and was treated there for $2^1/_2$ months.

Rtg. ex. Jan. 19, 1929. Since last examination there is further progression of the basal opacity and the signs of displacement. The apical cavity has increased in size still further; it has now a diameter of 5 cm., has very thin walls and without reaction in the surroundings. There is in addition a cavity behind C. 3. This has a diameter of 1.8 cm. and is surrounded by densified tissue. The bronchial lumina in the central parts of the right lung are now also considerably dilated. There are no changes in the left lung.

Rtg. ex. April 4, 1929. The old cavities have increased considerably in size. The upper one has now a diameter of 6 cm. and the lower one measures 2.6 × 3

cm. The walls of this latter cavity are now thinner than before. In addition there is now a cavity at the medial aspect of this. The bronchial lumina are still further dilated.

Has been at home since last examination and felt relatively well. Has had a cold on one or two occasions, however, and been in bed with a slight temperature for 3—4 days. Has lost 3—4 kg. in weight in a year. Appetite good. SR tested several times, has always kept at about 80 mm/hr.

Condition Sept. 25, 1929 satisfactory. No cyanosis or dyspnoea. Chest circumference 86 cm. Right half 42 cm., left 44 cm. Chest otherwise somewhat flattened in front. Dullness of scarcely medium degree over right lung in front. Dullness of the same intensity at the back above, below the scapula dullness of medium degree. Breath-sounds markedly weakened, of vesicobronchial character and covered with numerous râles of all sizes.

Rtg. ex. Sept. 28, 1929. The basal massive density unchanged. Displacement also the same. The thin-walled cavities have still further increased in size. There is still remarkably little reaction in the surroundings. Centrally the bronchial lumina are still further dilated. No changes in the left lung.

Since Sept. 28, 1929 pat. has been at home, and felt pretty well. In November pat. thought her breathing became heavy and she developed a cough. Slight expectoration. The temp. has all the time been normal. SR tested once a month; it was first 60 mm. (statement by patient) and subsequently 90—100 mm/hr.

Rtg. ex. Jan. 3, 1930 (Fig. 34). The lowering of the thorax, the displacement of heart and mediastinum and the elevation of diaphragm are on the whole unaltered. As compared with previous pictures the cavities are more oval with a much longer longitudinal axis and a somewhat shortened horisontal axis. In the left lung there have been added mottled tbc changes without any cavity formation.

Condition Jan. 27, 1930 satisfactory, as before.

Induction of pneumothorax on Feb. 1, 1930.

1/2	— 16 :	300 c.c.	— 20	— 4.
3/2	— 26	—10 : 500 c.c.	— 10	± 0.
5/2	— 19	— 7 : 600 c.c.	— 10	± 0.
7/2	— 16	— 3 : 400 c.c.	— 7	+ 2 etc.

Rtg. ex. Feb. 13, 1930 (Fig. 35 and 36): Right-sided pneumothorax. No exudate. Heart and mediastinum displaced a little to the left. Lower lobe collapsed. This also holds an expanded cavity which comes out very nicely on a lateral picture. The two upper lobes are moderately collapsed and the cavities are still considerably expanded. String-shaped and membranous adhesions are seen between the thorax and the two upper lobes as also a band-shaped tight adhesion from the diaphragm towards the collapsed lower lobe.

Thoracoscopy Feb. 27, 1930. Upper-most lobe easily recognised, adherent by delicate adhesions to the chest-wall in front and above. Lower-most lobe markedly collapsed, is firmly attached to the posterior chest-wall by a surface adhesion. The middle lobe with difficulty recognised, is lying as a lump attached to the posterior part of the lower lobe on a wide base, while the fissure between it and the upper lobe is wide open. Visceral pleura is reddened, with tbc-nodules showing through in several places.

The condition has on the whole remained the same wherefore cauterization of adhesions has been carried out latterly; only some of them, however, could be removed. The cavities were reduced to about half their original size. Clinically, on the other hand, marked improvement has set in and the patient is still undergoing pneumothorax treatment.

Case XI. E. Y. J., pharmacological student, aged 22 years. Admitted July 1, 1930.

Family history and previous illnesses of no interest.

In 1920 pat. was warded in hospital for 3 months for a left-sided pleurisy. Was then operated on for empyema. In 1925 the pat. coughed up without any previous illness a mouthful of blood. On subsequent examination tbc was found in the left lung. Was at a sanatorium for 5 months. Quite well on discharge. In the spring of 1928 had a cough and brought up small amounts of blood. He then went to Davos where he was treated for 6—7 months. Since that time pat. has been carefully examined yearly once or twice, the same changes being found all the time. Slight dullness over the left apex as far as I. 1 in front to corresponding level behind. Slight weakening of breath-sounds and a collection of small hard râles at the back.

Was generally Rtg. examined several times a year between Oct. 6, 1926 and May 24, 1930; the pictures showed on the whole a stationary fibrous tbc-process without cavities in the upper part of the left lung from the apex down to I.3 in front. Slight depression of the left apical area, otherwise equal on both sides. Heart and mediastinum in the mid-line. Even at the last Rtg. ex. on May 24, 1930 no change was found (Fig. 37). S. R. all the time normal.

About three weeks after the last examination the patient was taken ill with pyrexia, cough and a moderate amount of sharp pains in the left side. Fairly rapid aggravation of all symptoms. The temperature rose to 39°—40° C. Rather copious amount of yellowish sputa. On examination at home the apical changes were the same as before. Further down in the lung mild dullness and weakened breathing besides occasional inconstant adventitious sounds. The latter symptoms became worse after a few days and the pat. was sent to hospital under the diagnosis of exudative pleurisy.

On admission to hospital July 1 the general condition was found impaired. He was weak and tired but was otherwise powerfully built.

Examination of thorax shows less excursions on the left side with the circumference 1 cm. less than on the other side. On examination of lungs there is medium dullness above over the apex as far as C. 3 and below that marked dullness. Similar condition behind and in the lateral regions. Breathing bronchovesicular above, over the lower half markedly weakened. Right at the bottom in front there are also friction rubs. Râles can be heard over two-thirds of the lung in front as well as behind. Over the right lung there is a clear hypersonorous note.

Rtg. ex. July 2, 1930 (fig. 38). There is a considerable change in the appearance since May 24, 1930. The whole of the left half of the thorax above all in the lower parts is lowered with more slanting ribs and narrower interspaces than on the right side. Heart and mediastinum are considerably displaced to the left. This is particularly the case with the cardiac apex. Left diaphragm is raised. Over the left pulmonary base corresponding to the lower lobe there is a massive opacity. In the upper parts of the left lung there is an increased air-content, better defined than before against the densified parts. No changes in the right lung except emphysema.

Heart is pulled over to the left so that its right border is at about the left sternal margin. Nothing noteworthy in other organs. Exploratory punctures have been carried out both in front and behind where the dullness has been most marked, but with neg. result. Sputa are purulent but without tbc-bacilli in numerous tests. Condition on the whole unaltered lately. Temperature about 39°.

On examination on July 7 condition on the whole unchanged. Over the apex behind, however, more amphoric character of the breath-sounds. The bronchial

breathing over the middle of the lung is also more marked than before. No friction rubs now.

On July 23 treatment by pneumothorax was attempted with neg. result. The pat. has lately greatly improved, temp. normal. Sputa almost ceased. On physical examination, however, the condition is very much the same although the bronchial character of the breathing at the middle of the lung is somewhat more pronounced than before. The rtg. ex. yields on the whole the same appearance though the bronchi in the upper part seem more dilated than before.

Commentary. As in the previous group, we first intend to make a few brief comments on the individual cases and then enter into the question of the importance of lung collapse in cases of pulmonary tuberculosis.

In the first case, then, there is thus a short atypical history. There is no acute onset of disease but only some occasional slight pains in the affected side together with moderate cough and expectoration for a few months. On clinical examination the impression formed is one of fibrotic pulmonary tuberculosis in connection with pleurisy. Breath-sounds are much weakened and bronchial in character with numerous râles and a moderate amount of friction rubs. On Rtg. ex. there is the appearance of massive lung collapse with the associated characteristic pendulum movement of the mediastinum on respiration. The induction of pneumothorax finally showed that the lung was on the whole quite free and confirmed the presence of collapse. The small amount of exudate that appeared on the induction of pneumothorax can surely not have been of any importance for the estimation of the radiogram. We have been unable to find out in what way the collapse had arisen.

The second case is rather like this one. Yet the onset is more acute; already then, however, one formed the impression that it was a case of pulmonary tuberculosis with pleuritic shrinkage, wherefore it was considered hopeless to try treatment with pneumothorax. The illness was of a progressive nature. At our examination there were marked changes with cavities over the upper part of the left lung. The Rtg. ex. gave a similar appearance as in the first case yet with more marked cavity formation. The induction of pneumothorax finally made certain that the lung was free. From clinical point of view it is of great interest to observe — as has also been done in several other cases — that the marked dyspnoea present became much improved after pneumothorax had been induced.

In the third case, on the other hand, the history is of great interest. The patient is taken ill in Nov. 1927 with the clinical picture of pleuritic exudation. After treatment at home for two months she is admitted to hospital where on physical and Rtg. ex. one obtained the impression of healed pleurisy with fibrous infiltration. Exploratory puncture gave negative result. At this time one could only see a few small cavities in the right lung. During subsequent years the disease develops with new cavity

formations, at first in the apex and later further down in the lung; these cavities gradually become larger and show remarkably little reaction in the surrounding tissues. The cavities have a noteworthy shape in that they are at first nearly circular but lately, on the other hand, appear with a slight bulging towards the base of the lung. On clinical examination in hospital one still found obviously weakened breath-sounds of broncho-vesicular type with numerous râles. Even then one was most inclined to view the case as a pulmonary tuberculosis that had developed after pleurisy with subsequent fibrosis. The massive density persists on the whole unchanged as also the displacement of heart and mediastinum. Yet at our examinations we were able to establish pendulum movement of mediastinum. Clear bronchial dilatations also gradually appear in the same lung.

The first phase of the patient's illness is only incompletely followed. It has been looked upon as an exudative pleurisy. Naturally it is impossible to exclude that this really has been present but the subsequent development, particularly the induction of pneumothorax, would seem to disfavour this view. It would seem most likely, therefore, that already at the onset a partial collapse of the lower lobe was present. It is impossible to ascertain more closely how it had arisen. The fact that adhesions were present in the pneumothorax does not disfavour the assumption of collapse. On the contrary one often finds friction rubs mentioned in this condition. In this case they were present during the first hospital period. Even from the point of view of morbid anatomy extensive pleuritic changes are described after collapse. The skiagram finally shows the ordinary appearance of partial pulmonary collapse. In this case, too, one managed to induce pneumothorax which also confirmed the presence of lung collapse.

The development of the cavities is of great interest and will be dealt with later.

The fourth case is of interest because the patient has been exceedingly carefully followed for four years; during this time there was quite a mild and stationary process in the upper part of the left lung. The last time this was established was on examination of the patient three weeks before the onset of the last illness. This is characterised by an acute onset with cough, high temperature and fairly severe pain in the left side. The breath-sounds are on the whole weakened and of bronchial character. On account of the marked dullness present together with the above mentioned symptoms exudative pleurisy was diagnosed. In this case it was the Rtg. ex. showing displacement towards the affected side that settled the diagnosis of lung collapse. The subsequent course was only followed for a short time. As is the case in some of the cases described in the literature the acute symptoms abated; the temperature fell but the physical

and Rtg. changes remained on the whole as before, yet dilatations were seen to form in the upper lobe. Exploratory puncture and attempts at inducing pneumothorax were negative. Nor could one find any cause of the collapse.

In reviewing these four cases from clinical point of view one finds, in the first place, in case VIII that the onset has been insiduous without any typical symptoms. The clinical picture mostly resembled an old fibrous pulmonary tuberculosis after an attack of pleurisy. In case IX the onset is more acute, the course more malignant, other factors being similar. True that in case X the onset was acute or subacute with symptoms which were regarded as those of an acute pleurisy; in case XI, again, the onset was also acute and the same diagnosis was made. In comparing these cases with those few cases of collapse in pulmonary tuberculosis published earlier one finds that in the majority of them there is no acute onset.

The diagnosis has above all been made on the strength of the Rtg. ex. which would seem to be characteristic enough. Moreover pneumothorax was induced in three of the cases which showed that pleuritic shrinkage could be excluded.

In accord with previously described cases is also this fact that the lung-collapse after having entered a chronic stage does not seem to cause the patient any subjective discomforts or to impair the strength of the patient to any appreciable extent.

It is further of interest that in these cases one has the picture of occlusion of the bigger bronchi with a markedly weakened breathing. On the other hand we have been unable to decide upon the cause of this occlusion. In none of the cases has any bronchoscopic examination been carried out. The Rtg. appearance is not particularly in favour of any central change in the form of glands compressing the bronchi from without. In the last case, in particular, the Rtg. ex. was carried out three weeks before the onset of the collapse and no enlarged glands in the hilum could be detected.

Case X is in one respect of particularly great interest. In this case the patient had in all probability been having her collapse for about two years. The interesting point in this case where the tuberculosis, judging from the temperature and general condition, was relatively mild is that cavities had arisen of a noteworthy appearance. They were, as already mentioned, large and vesicular causing very little reaction in the surroundings. The sputa were slight during the whole of the illness and one could scarcely realise that the patient had had a destructive liquefying process of the extent her cavernous system led one to assume. It has entered our minds,

therefore, that a massive collapse in a case of pulmonary tuberculosis may in the long run have a fatal effect by enlarging cavity formations.

The same applies here as in the cases of bronchiectasis previously described. By the negative pressure in the pleural cavity increasing many times over it tends to expand already existing cavities which must become larger, the greater the collapse and the negative pressure are. According to an investigation by ARON the variations in the pressure on respiration are normally: — 4 — 7 H_2O, as measured in 36 normal individuals. This seems to accord with the general consensus of opinion. In a case of acute collapse FARRIS found a pressure of — 10 — 16 cm. H_2O. In three cases of post-operative collapse ELKINS found pressures of — 16 — 20 cm. HABLISTON has examined 4 cases of which 1 was in connection with an accident and found a pressure of — 13 cm. H_2O. This figure would not seem of much value as the patient died from the accident two hours later. In case 2, pulmonary collapse in connection with an old tbc, he found a pressure of — 12 cm. and in case 3 — 24 — 27 cm. The cause of collapse in this case was a benign tumour which filled out one of the main bronchi. In case 4, where one of the main bronchi was compressed by an aortic aneurysm, the negative pressure was — 33 — 43 cm. H_2O.

According to our own findings the pressure in cases of collapse after haemoptysis has been as follows:

Case 2 (K. G. M.) in our previous paper about — 30 cm.

Case 3 (K. H.) in our previous paper — 8 — 4; — 9 — 3.

KYLIN's case about — 30 cm.

Collapse in connection with bronchostenosis and bronchiectasis.

Case IV (S. N.) — 22 — 12 cm. H_2O.

Case V (J. E. B.) — 40 — 14, — 32 — 10 cm. H_2O. Case VI (K. J. H.) — 40 — 36 cm. H_2O.

Collapse in connection with tbc. pulm. without haemorrhage.

Case VIII (D. T.) — 34 — 28 cm. H_2O. Case IX (E. R.) — 23 — 20. Case X (R. B.) — 20 — 4, — 26 — 10. Case XVII (J. B.) — 20 — 13.

Collapse in connection with tumours.

(Two of these only of interest.) Case XIV. (K. V. P.) — 13 — 12, — 12 — 11. Case XV. (A. K.) — 8 — 5, — 10 — 3 cm. H_2O.

It will be clear from this account that it is particularly characteristic in cases of lung collapse to obtain an unusually high negative pressure, quite naturally owing to the rapidly diminished volume of the lung. It is further evident that this negative pressure is dependent upon the size of the collapse, it being proportionally lower in cases of partial collapse. Similarly must the pressure become reduced, if such changes arise in the lung or its surroundings that may serve the object of equalizing it, such as large cavitations, bronchiectasis, emphysema or exudates in the pleural cavity,

marked displacement of the mediastinum to the affected side and so on. Without entering more closely into the different cases it is easy to find the effect of these various factors. It is this raised negative pressure that in our view has played a fatal rôle in cases IX and X and contributed to the formation of these large cavities. It is of interest to note that PACKARD has described a case with massive collapse in pulmonary tbc. with a cavity of identically the same appearance as in case X. In PACKARD's case the collapse gradually cleared up and on Rtg. ex. a few years later both the collapse and the cavity were found to have completely disappeared. The case has not been followed any more closely in the meantime. The author does not comment upon it but to us it seems possible that with reduction of the negative pressure in conjunction with cessation of the collapse there was a much better chance of healing with the above described result.

In our opinion, therefore, the pulmonary collapse is at least not always likely to have a favourable prognosis even in the case of the clinical symptoms appearing mild enough after some time's observation. By creating a marked rise in the negative pressure it can, as mentioned, give rise to the development of or enlargement of already existing cavities. A more extensive collapse of one or several lobes, however, is probably relatively rare even if attention has not before now been sufficiently directed to this factor. On the other hand, it would seem as if the question of frequency and importance of numerous smaller collapses through occlusion of ramificating bronchi, previously described in connection with our bronchiectatic cases, were entirely uninvestigated. Such small collapses may probably quite well occur in great numbers in one lung and ought then also to give rise to a heightened negative pressure which may have the same deleterious effect for the cavity formation. It may be argued, it is true, that in pneumothorax patients in whom one wishes to finish with this treatment, equally high negative pressures have been found, yet one has been unable to trace during a long time of observation any effect on the pulmonary tuberculosis in respective cases. The difference is this, however, that in these cases one was dealing with tuberculosis under healing while here it is a question of a tuberculosis under development. It must further be admitted, we suppose, that in terminating the pneumothorax treatment a critical period sets in for the patient during which the tuberculous infection has a tendency to flare up which also not infrequently happens. The general experience of the beneficial effect in all therapeutic methods aiming at a reduction of the volume of the lung, when thus the lung is too small for the room it is intended to fill up, may also be imagined as partly due to local collapses of the lung and not only to parenchyma destroyed through tuberculous tissue. The question is too big and too little investigated to allow anything but this little hint. Similarly we

have refrained from discussing here other possible causes of development or enlargements of cavities such as kinks or valvular formations with accompanying positive pressure in the cavities (LAURELL) because our material has not given us any cause for dealing with this question. Naturally we do not wish to deny the possibility of such conditions existing. Regarding treatment FARRIS and HABLISTON have also suggested and performed partial pneumothorax in cases of acute massive collapse whereby the symptoms immediately improved. We would like to add that in all the different forms of modern collapse therapies (pneumothorax, phrenicoexaires and thoracoplasty) the intrapleural pressure becomes reduced.

d) Massive collapse of the lung in connection with lung tumours

While in the previous groups we have mainly been dealing with the effect of the collapse on the lung tissue and its cavitations, we intend in this group, pulmonary collapse in connection with lung tumours, mainly to deal with its effect on the pleural exudate, especially its configuration.

A well-known condition is collapse as a sequence of stenosis of a main bronchial branch in cancer of the bronchi. It is true that in OTTEN's classical work on »Die Röntgendiagnose der Lungengeschwülste» pulmonary collapse is not mentioned as a complication in cases of tumours of the lung but in his description of the appearance of lung tumours, however, he describes a shrinkage of the thoracic wall and displacement of heart and mediastinum to the affected side as also elevation of diaphragm as ordinary and characteristic findings in cases of lung tumours. These phenomena, however, would seem to be a consequence of the state of collapse in the lung complicating the picture. LENK refers in his great work to atelectasis or pulmonary collapse as a complication that may occur and also describes the Rtg. appearance of it. In his view, however, this condition is evidently not of so common occurrence as we think being the case. Nor do other larger works on the roentgenology of lung tumours (SCHMOLLER, ASSMANN, BÉCLÈRE, CARMAN, HYDE and HOLMES a. o.) seem to pay sufficient attention to this condition.

Judging from the illustrations published it would seem as if many of the described forms of the so-called »Lappencarcinoma» were to a large extent combined with a complicating collapse of the lung.

The question of location and configuration of the exudate in cases of lung tumours, especially when complicated with pulmonary collapse, has not earlier been more closely discussed. LENK says: »Der freie pleurale Erguss ist charakterisiert durch einen homogenen, intensiven, basalen, verschieden hoch reichenden Schatten, dessen obere Grenze meist unscharf ist und schräg gewöhnlich bogenförmig von innen nach aussen aufsteigt.» Thus a description which entirely coincides with the appearance

of free exudate in the pleura under other conditions. There is no doubt that such is the condition in cases of free exudate in pulmonary tumours uncomplicated by collapse of the lung. To illustrate the behaviour of the free exudate in these cases, which are not so unusual, an account will be given below of five cases of lung tumours complicated with massive collapse and pleural exudate.

Case XII. B. L., married, aged 42 years.

Admitted Jan. 4, 1928.

Previously always in good health. In Jan. 1927 pat. was suddenly taken ill with lobar pneumonia with a temp. of about 38°. Was in bed for 1½ week. Pleura was not explored. Had blood-stained expectorations. After that well again. Present illness began in April 1927 when pat. while coughing suddenly got her mouth full of pure blood. Consulted a doctor who found nothing wrong with her lungs except bronchitis. This bleeding began in connection with menstruation. Altogether she coughed up about a coffee-cupful of blood in a couple of days after which the bleeding stopped and she again felt quite well. In May pat. again in connection with her menstruation brought up blood and was then in hospital for 10 days.

Rtg. ex. on May 23, 1927 shows the heart and mediastinum to be slightly displaced to the right. At the base on the right side there is a massive opacity with a sharp upper limit running from the medial aspect above outwards and downwards.

The next haemoptysis occurred two months later. During each period of bleeding she coughs up from about a coffee-cupful to half-a-litre of blood.

Condition Jan. 4, 1928 relatively unimpaired. Nutrition and musculature normal. On superficial examination of the lungs in front there is heard on the right side over an area corresponding to I.3—I.4 a fairly great amount of râles of various qualities. Breath-sounds everywhere with a tendency to bronchial character. Heart: Nil. Abdomen nil. HB 63 %, red blood-corpuscles 4.12 mill., white cells 7,500.

Jan. 7. On examination of lungs marked dullness over right lung below and behind as far as scapular angle. Weakened bronchial breathing here with numerous râles. In front marked dullness to the mamillary level and bronchial breathing with a sparing amount of râles. Slight oedema and some tenderness over the dull area.

Rtg. ex. Jan. 7, 1928 (Fig. 39). Right half of thorax depressed particularly in its lower parts. Heart and mediastinum displaced to the right. At the base of the right lung a massive opacity with a sharp upper limit running from within above outwards and downwards. In the hilum a glandular opacity, almost the size of a walnut. Within the upper pulmonary area there is an increased amount of air indicating emphysema. No changes in the left pulmonary area but for an increased amount of air.

Jan. 13. On puncture an almost clear somewhat yellowish fluid was obtained. Sediment mainly lymphocytes. No bacteria. No tbc. Bacterial culture neg. Guinea-pig tests neg.

Jan. 16. Withdrawal of 600 c.c. of almost clear yellowish fluid.

Jan. 17. Rtg. ex. (Fig. 40). Right-sided pneumothorax with free exudate which in the upright position extends with its horisontal fluid level as far as I.5 in the mamillary line. The upper lobe seems to be slightly compressed and sur-

rounded by a cloak of pneumothorax 1 cm. broad. This lobe shows fairly satisfactory air-contents and the main bronchus leading to this lobe can be well recognised. The two lower lobes, on the other hand, are completely collapsed and no air at all can be seen in these. The glandular shadow described before surrounds the lower main bronchi which give no evidence of air being present at the distal aspect of the gland.

Jan. 19. Withdrawal of 275 c.c. fairly clear but yet somewhat blood-stained fluid. Esbach 2.5 %. Moderate amount of red and white blood-corpuscles, lymphocytes, endothelial cells.

On thoracoscopy the diaphragm is at once seen to protrude in a dome-like manner high up in the chest cavity. The 3 lobes of the lung are well visible. The uppermost lobe is pink in colour, contains air and is apparently normal. The middle small lobe has changed most, is of slate-grey colour, rough here and there and fairly air-less. The posterior lower lobe is also fairly airless, the parts next to the middle lobe being altered in a similar manner; otherwise no demonstrable changes. Nowhere are there any fibrinous deposits of the usual appearance barring some exceedingly thin free membranes in the pleural sinus but no transverse membranes that may explain the peculiar configuration of the exudate.

Jan. 21, 1928. Rise of temperature. Complains of pains in the abdomen and on the right side. Abdomen soft, very tender, not distended on the right side of epigastrium.

Rtg. ex.: Large pneumothorax cavity on the right side. The lung, even the upper part, is seen relatively well collapsed. From here, however, an adhesion is seen extending backwards and outwards. Basal horisontal fluid running out in supine position.

Transferred to surgical department for operation. Subphrenic abscess suspected. No such abscess was found at the operation. Patient died on Jan. 23.

Autopsy. In left pleural cavity about 150 c.c. of a clear yellow-red fluid. In right pleural cavity a brownish, turbid fluid with small flakes of fibrin.

Left lung: volume moderate. No pathological changes. The upper lobe of the *right lung* was flimsy, doughy and without that air-crispy consistence. Middle lobe the size of about a hen's egg. Lower lobe much collapsed, firm and doughy. On slitting-up the air channels to the right lung the lumen of the bronchus just below where it is given off to the upper lobe is seen to be markedly narrowed. This constriction is occasioned by a yellow-white smeary sort of stuff exuding from the bronchial wall extending downwards for about 2 cm. Lumen entirely filled out. Below this narrowing (in middle and lower lobes) the bronchi were wide and thin-walled and filled out with a thick grey-yellowish slime. In addition these latter lobes presented a firm, flesh-like consistence and a marbled grey-red cut surface from which a very small quantity of slightly aerated fluid exuded. In the hilum of the right lung there were two lymph-glands quite the size of hazelnuts of a hard consistence and an even surface.

Microscopical examination. Undifferentiated carcinoma.

Case XIII. J. V. L., farmer, aged 58 years.

Admitted Jan. 3, 1930.

In April 1929 pat. was taken ill with influenza with coryza, coughing and rise of temp., from which he recovered after a month. In conjunction with his influenza pat. had muscular rheumatism in neck and trunk. These complaints have continued ever since. At the beginning of Oct. pat. again started to cough running a subfebrile temp. which has been going on ever since; his strength has

gradually diminished. Sputa have been made up of a sparing amount of white mucus. On Dec. 28 an exploratory puncture was made, an almost clear fluid being obtained. He has lately lost some weight.

Condition Jan. 3. Powerfully built. Chest: emphysematous. On the right side medium dullness from the scapular spine, below the angle marked dullness to wooden percussion note. Upper half weakened breath-sounds, lower half much weakened bronchial breathing, no râles. Nil of note in other organs.

Pleural exudate after exploratory puncture blood-stained and feebly turbid. Sp. w. 1,020. Rivalta + Esbach 5 %. Tbc. neg. No other bacteria. Lymphoc. 95 %, leucocytes 5 %.

Jan. 4. Rtg. ex. (Fig. 41 and 42). Lower part of the right half of thorax is clearly sunken with more slanting ribs and narrower interspaces than on left side. Heart a little displaced to the right. In sitting position there is seen a triangular massive opacity completely covering the diaphragm and which has a somewhat ill-defined limit above. This boundary is running from below laterally to above medially. Above this there is a band-shaped shadow in the interlobar space. In supine position the basal opacity spreads out entirely over the whole pulmonary area.

Jan. 9. Withdrawal of about 1.5 litre of blood-stained exudate. Thoracoscopy: upper and anterior lobe holding much air and light-coloured. Right behind a fleshy fringe projects, probably the lower-most lobe. Diaphragm is of usual appearance yet with a few thickened parts on the dome possibly of tumorous nature. Right in front there is a polypous formation of indefinite kind. The parietal pleura is of a strange appearance. Opposite the ribs there are parallel fairly high tissue ridges resembling fatty tissue. Yet no certain tumour metastases. No fibrinous membranes on parietal pleura or lung. On the other hand there are a few flakes of fibrin from the under surface of the lung.

Rtg. ex. Jan. 9 (Fig. 43). After drawing off 1,500 c.c. of fluid and inflation of air there remains in sitting position a small amount of free fluid with a horisontal upper limit. The lower lobe is completely collapsed while the two upper ones are only moderately so.

Jan. 21. After continued pneumothorax treatment 1,000 c.c. of a somewhat lighter sanguinolent fluid were withdrawn. On thoracoscopy the same changes are on the whole seen as last time.

Jan. 28 Rtg. ex. (Fig. 44 and 45). There is no longer any pneumothorax on the right side. In sitting position the exudate has now mainly the same position and appearance as at the first examination on Jan. 4, 1930 with an upper limit running from the hilum laterally and downwards towards the thoracic wall. The fluid runs out in supine position. In addition fluid has collected in the left pleura in the usual position and of ordinary appearance.

Jan. 31. In the skeletal parts of both shoulder-joints there are numerous bone destructions with sclerosis in surrounding bone. The picture is typical of osteoplastic cancer metastasis.

Then followed a time of gradual aggravation of the general condition. On superficial examination of the chest organs conditions were fairly much the same. Hard, fixed, glands, the size of walnuts, also developed on the neck (tumorous metastases).

Patient died on May 6. Autopsy refused.

Case XIV. K. V. P., aged 49 years, merchant.

Admitted Dec. 14, 1929.

Present illness began acutely on Aug. 1, 1929 with headache, sensation of cold and coughing without expectoration. Temp. 39°.5, no stitch. Temp. has

since varied between 36°.8—37°.5 in the mornings and 38°.5—39°.5 in the evenings. Since Oct. 15 there has been a regular temp. of about 39° in the evening. Mucous sputa. Was admitted in hospital where the pat.'s illness was regarded as a septic condition. General condition unimpaired. Moderate coughing, mucoid sputa. Emphysematous thorax. Rhonchi on both sides. Heart nil.

While in hospital pat. became insane and had to be admitted to a mental department.

Oct. 21. Condition on the whole unaltered. He has been quiet apart from a couple of brief attacks of restlessness in connection with rise of temp. He feels very tired. Skin sometimes slightly icteric.

Admitted to the surgical department of this hospital on Oct. 23, 1929.

General condition fairly satisfactory. Some coughing, mucoid sputa. Temp. 38°—39°. Mentally balanced, occasionally a little confused. SR 61 mm./1 hr.

Oct. 24 Rtg. ex. (Fig. 46). In the upper part of the right half of the chest the ribs are more slanting and the interspaces narrower than on the left side. Heart and mediastinum are displaced a little to the right. This displacement is more marked during inspiration than during expiration (respiratory pendulum movement). Over the whole of the upper part of the right lung there is a massive opacity showing a well-marked lower lobar limit on level with I.3 in front. Basally there is a massive opacity completely covering the diaphragm and which has a well-defined upper boundary running from below laterally upwards and medially. In the lung area between these massive opacities there is an increased air-content like in emphysema. A couple of thin interlobar shadows appear within this area between the lower and middle lobes. Hilum is somewhat elevated. No changes in left lung.

Rtg. ex. Nov. 5. Displacement of heart and mediastinum is more marked than on the last examination as also the respiratory pendulum movement. The basal opacity on the right side has become larger and extends somewhat higher up.

Nov. 30 Rtg. ex. (Fig. 47): Apical opacities unaltered. The basal density is still further increased and has now a more marked bow-shaped limit with the convexity upwards. Displacement of heart and mediastinum not so well marked

Dec. 14. Admitted to the medical department. General condition good. No dyspnoea, cyanosis or oedema. A few lymphatic glands in right supra-clavicular fossa close to the sternomastoid, fairly hard, non-tender and fixed, one of which is as large as a nut. Very marked dullness over right apex in front and behind as far as I.1 with a sharp lower limit; marked bronchial breathing with amphoric character over this area. Right at the bottom of the right lung there is dullness 2 finger-breadths higher up than on the left side with inhibited breathing. The dullness perhaps extends somewhat higher up nearest the spine.

Over the whole of the right lung the breath-sounds are weaker than on the left side. Slightly stridulous breathing particularly when pat. is agitated. Heart, abdomen, urine nil.

Dec. 17. Puncture of right pleura: 10 c.c. of a yellow-green not quite clear fluid. Rivalta pos. Esbach: 5 %. No bact. No tbc. Neutroph. 30 %, lymph. 60 %. Ep. cells 10 %.

Dec. 18. Induction of pneumothorax. Initial pressure —13 —12; Insufflation of 100 c.c. Final pressure —12 —11.

Dec. 20. Rtg. ex. After insufflation of 600 c.c. the Rtg. appearance has altered considerably. There is now a free exudate at the base with a horisontal limit in sitting position. In supine position the exudate runs out in the thorax. The upper lobe is completely collapsed and partly adherent to the thorax by a few band-

shaped adhesions. The lower lobes are only moderately collapsed and surrounded by a narrow cloak of pneumothorax.

Dec. 22. Thoracoscopy. The visible upper part of the lung light-coloured and air-containing, a few short adhesions laterally upwards. Apex not visible. No changes in the pleura but for flushing of the parietal layer. Much air in lower lobes particularly in front. The lower-most lobe presents a transverse girdle low down, though not at the edge, which is wrinkled and less air-containing. Diaphragm flushed, otherwise no changes. Between the lobes small adhesions. *Absolutely* no fibrins or other adhesive formations in the lower part of the thorax. Withdrawal of fluid, 50 c.c., of the same appearance as on Dec. 17. Esbach 4.2 %, sp. w. 1,020.

Jan. 5. At about the time of the New Year patient became more and more confused and troublesome. Was transferred to mental hospital. His condition was all the time there very restless and no closer examination of the chest was carried out. Rather unexpectedly pat. died on Feb 12, 1930.

Autopsy: (prof. BERGSTRAND).

Physical development ordinary. As compared with the left side the right half of the thorax is somewhat sunken. On opening the chest the right side reveals firm connective tissue adhesions between the upper lobe and the anterior and lateral walls of the chest. The middle and lower lobes are here and there attached to the chest wall by delicate fibrinous adhesions. There is no difficulty therefore in detaching the middle and lower lobes. In doing this about half-a-litre of clear thin fluid admixed with fibrinous debris is obtained in the pleural cavity. Behind and paravertebrally the upper lobe is also free; a canal is thereby formed allowing three fingers to pass and which connects the lower part of the pleura with the apex of the pleural cavity where free exudate is also to be found. The lower and middle part of the right lung are covered with thin fibrinous deposits. The parenchyma in these lobes everywhere contain air, yet more so in the lateral than in the medial parts. The lungs are removed in one piece, the right with parietal pleura attached corresponding to the upper lobe. The trachea and bronchi are then cut upon. It is then found that that branch of the right main bronchus going to the upper lobe (bronchus eparterialis) shows at the point of bifurcation from the main bronchus a plate-like thickening of the mucous membrane extending round the lumen causing this to be narrowed. This infiltration just mentioned extends down for some distance into the bronchus and also for a bit up into the main bronchus where it gradually disappears. The infiltration is grey-white in colour and has caused ulceration of the surface. It also extends deep down into the bronchial wall. Outside the bronchus in the lung-parenchyma itself are seen a couple of grey-red, rounded well circumscribed tumours, the size of hazel nuts. The upper lobe of the right lung is quite atelectatic and presents a firm grey-black airless cut section. The finer ramifications of the bronchi are markedly dilated in the periphery forming bronchiectatic cavitations. These cavities are filled with a thick yellow pus. The upper part of the lower lobe, on the other hand, extending behind high up towards the apex, is air-contained, soft and red in colour. The left lung shows a diffuse purulent bronchitis. Metastases are present in the mediastinal lymph-glands at the bifurcation, in the paratracheal lymph-glands and in the inferior cervical lymph-glands on the right side. There are no metastases in the abdominal lymph-glands, but a tumour, the size of a tangerine, is found in the right suprarenal gland.

Microscopic examination shows the tumour to consist of small undifferentiated cancer cells lying in strings and columns. Nothing has been seen indicating a

hypernephroma. The tumour must therefore be regarded as a primary bronchial cancer.

Case XV. A. K., married, aged 58.

Admitted Jan. 29, 1930. S:t Erik Hospital.

No previous pulmonary disease. In 1923 was treated at Radiumhemmet for cancer of the cervix (squamous cell carcinoma). Re-examined several times, everything found in order. Has had a cough since 1929, at first without any sputa, last six months a sparing amount of yellow-white blood-stained expectoration. During the last month breathlessness, night-sweats and pyrexia. Aching pains in the right part of the neck. Emaciation.

Condition on admission fairly satisfactory, flesh and musculature somewhat reduced. Tendency to watch-glass nails. On the examination of lungs marked dullness over right lung in front as far as I.1, behind as far as scapular angle. Bronchoamphoric breathing. No certain adventitious sounds. Otherwise no definite changes.

April 9. Bronchoscopy (FRENCKNER). Posterior wall of the right main bronchus bulging inwards giving to the lumen a sickle-like appearance. Mucous membrane in small wrinkles, surface intact.

Impossible to inspect the lumen of the bronchus to the right upper lobe on account of the considerable rigidity present in the pat.'s neck. It would seem likely that this bronchus is the seat of some pathological superficial process of the mucous membrane, as bleeding occurs on the slightest touch with an aspiration canula. The bronchoscopical appearance is mostly like that present in tumour of the lung.

Rtg. ex. April 9. (Fig. 49). The upper part of right half of thorax is a little depressed with ribs more on the slant and narrower interspaces as compared with the left side. No decided displacement of heart and mediastinum. The angle between heart and diaphragm on the right side is filled out by a massive opacity with a well defined upper limit running from above medially in a direction laterally and downwards. Massive opacity over the upper part of the right lung area with a distinct interlobar lower limit. In the right hilum there are a couple of shadows, the size of up to hazel-nuts. No changes within the left lung.

Sputum: Quantity inconsiderable, not measured. Streaks of blood here and there. No tbc. Heart nil. Blood-pressure 155/90. Abdomen nil. Urine nil. WR neg. SR 46 mm./hour. The pat.'s condition did not subsequently undergo any appreciable variations but she slowly became worse. The local clinical signs have on the whole remained stationary. Occasionally there have been feverish exacerbations with purulent blood-stained sputa in varying quantities.

Rtg. ex. April 15. The lowering of the right thorax is a little more marked than before. There is also now a slight displacement of heart and mediastinum to the right. This displacement is more marked during inspiration than during expiration (respiratory pendulum movement). The massive density over the apex and the diffuse opacity filling out the heart-diaphragm angle at the base are unaltered. The right main bronchus is compressed and the right contour of the lower part of the trachea shows an impression just above the bifurcation.

Rtg. ex. April 29. Since the last examination there has been added an irregular cavity. No secretory layer. Otherwise condition the same.

Rtg. ex. May 20 (Fig. 50). The cavity formation in the upper part of the lung is now larger. There is now within this cavity also an obvious secretory layer.

On account of the liquefaction arisen in the upper density and the increased amount of blood in the sputa pneumothorax was induced on May 23.

Pressure — 8 — 4 : 400 : ± 0.
May 24 —10 — 3 : 250 : — 4 ± 0.
May 26 — 7 — 2 : 250 : ± 0.

Rtg. ex. May 23 (Fig. 51). After insufflation of gas into the right pleura the opacity in the heart-liver angle has disappeared and a free exudate is seen there with a horisontal upper fluid level. The lower lobes are moderately collapsed as a result of the pneumothorax but show fairly satisfactory air-contents. The upper lobe shows no air-contents in the parenchyma but well so in the cavity which appears as before. Heart and mediastinum are now displaced a little to the left.

June 10. Marked dyspnoea and cyanosis. Tachycardia and a poor general condition.

June 13. Death. The following were the post-mortem findings as regards the chest-organs (Dr. KARLMARK): Left lung shows a considerable antracos. A couple of small tumours in the parenchyma, otherwise nothing of note.

The lower lobe of the right lung is *entirely free from the chest-wall and the diaphragm*. The middle lobe has a couple of adhesions and the upper lobe a slight adhesion. The lateral part of the upper lobe and the upper lateral part of the middle lobe contained a cavity, barely the size of a fist, occupying more than four-fifths of the circumference of the upper lobe and more than one-third of that of the middle lobe, and the walls of which were covered with smeary, grey-yellow, slimy masses. After scraping off these masses the walls of the cavity proved to consist of firm somewhat fibrous tissue. The finer bronchioles to this lung were slit open and it was then seen that the biggest bronchiole leading to the middle lobe after a slight constriction opened directly into the cavity. Other bronchi seen by the naked eye were found normal. The middle lobe is studied with nodules quite the size of peas. The bronchi here contain a fairly great quantity of pus. In the remaining small part of the parenchyma of the upper pulmonary lobe there are also some firm nodules.

The microscopical examination showed cancer of the nature of squamous epithelium.

Case XVI. J. B., physician, aged 62.

Previously always in good health. Has generally been prone to bronchitis. The onset of the present illness cannot be definitely fixed in time. A year ago he noticed he could not walk as well as before, a symptom which got rather worse during the winter. During the winter had a cough with a sparing amount of sputa, occasionally blood-stained. In the evenings the temperature was slightly raised. In the spring he got worse with more constant cough and a raised temperature; lost a little weight. Pat. was examined the first time a month and a half ago, when dullness was found over the right apex; sputa were examined with negative result for tbc. Rtg. ex.: Right thorax depressed with more slanting ribs and narrower interspaces than on left side. Heart and mediastinum displaced a little to the right side. Over the upper part of the right lung-field there is a massive opacity with a lobar lower limit on the level with I. 3 in front. Over the right base of the lung there is also a massive opacity covering the diaphragm. This shadow has a sharp upper limit running from above medially downwards and outwards. No changes in left lung. — No improvement worth mentioning during the last month. Examination Oct. 2, 1930: General state of health satisfactory,

flesh and musculature good, healthy appearance. On examining the chest there was slight depression and lagging behind on respiration of the right half of the chest, marked dullness over the upper part of the right lung as far as I. 3 and corresponding level behind, beyond that an area, the size of the palm of a hand, with relatively normal percussion note. Over the lower parts of the lungs there is also marked dullness limited above at about the level of the scapular angle. Breath-sounds over the apex broncho-amphoric in character, yet clearly stronger medially and weaker towards the side. Over the middle part of the lung weakened fairly normal breathing, occasional râles behind. Over the lower dull parts breath-sounds much weakened, lowermost breathing inhibited. Hypersonorous note over left lung, otherwise no diseased changes.

Heart nil. Abdominal and urinary organs nil. A gland, barely the size of a cherry, in right axilla. Otherwise nothing of note in the lymphatic system. SR 5 mm/hour.

Rtg. ex. Depression of right thorax and displacement of heart and mediastinum as before. Similarly regarding the massive lobar opacity over the upper part of right lung. The basal opacity, on the other hand, has increased considerably and its upper limit is now running more horisontally. On examination in supine position this opacity is seen to disperse over the lung-field, causing the diaphragm to be seen. This appears much higher than before.

Commentary. These five cases of lung tumour with massive collapse have been brought together into one group for joint discussion as they present a few similar symptoms of great interest which before now have been differently interpreted.

As a common feature of them all is the free exudate in the pleural cavity, localised in a way which is quite contrary to the ordinary free pleural exudate. As is well known these exudates appear in sitting position and in sagittal projection as a shadow with a slightly concave oblique most often indistinct boundary, in a direction from above laterally inwards and downwards (see Fig. 55). In the cases we are now dealing with the contour of the exudate has quite a different ap-

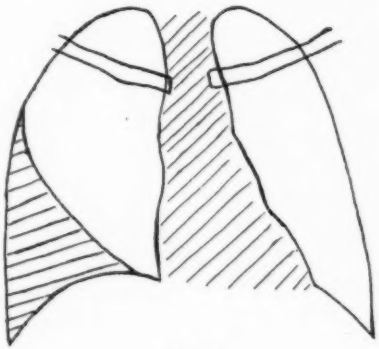

Fig. 55.

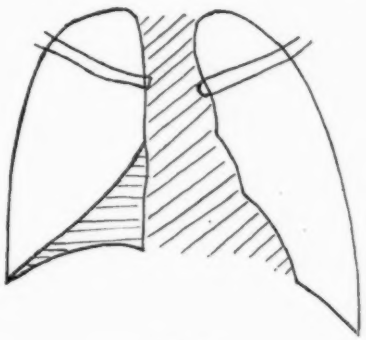

Fig. 56.

pearance rendering it impossible to recognise it as such. The outline of the exudate in these cases is sharp and passes obliquely from within and above downwards and outwards. (Fig. 56.).

In a paper by GOLDEN on the subject of »The effect of bronchostenosis upon the roentgen-ray shadows in carcinoma of the bronchus» the author has in three cases described and shown pictures (Fig. 13 and 18) with shadows similar to those in our cases. He has interpreted this change thus that »the inner third of the right side of the diaphragm is pulled up». He continues: »Examination of the pathological specimens and consultation with the pathologists has failed to produce an explanation of its mechanism». K. KORNBLUM has also published a case with a similar basal density. In his case the exudate was also discovered in the pleura by puncturing but the author does not discuss the connection between this density and the exudate. HYDE and HOLMES also publish similar pictures but regard them as an elevated diaphragm.

In his great monography about »Röntgendiagnostik der intrathorakalen Tumoren und ihre Differentialdiagnose» LENK submits a number of pictures (Fig. 28, 45, 63, 76 and 77) which greatly resemble our cases. In ASSMANN's big hand-book we have further found a picture (Fig. 296) with a similar shadow in a case of bronchial cancer with stenosis of the right lower main bronchus. However he submits no description of it. PACKARD describes a shadow of that nature as an elevated diaphragm. It will be clear from these references that this basal shadow is by no means so uncommon.

By closer examination of these shadows, however, one will find a pointed elevation directed towards the hilum (Fig. 57). Yet it is impossible to explain this alone as an elevated diaphragm or as a paresis of that organ. Solely collapse of the lower lobe or encapsulated mediastinal pleuritic exudates (Fig. 58) give appearances more in accordance

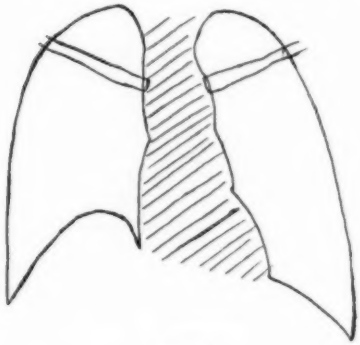

Fig 57.

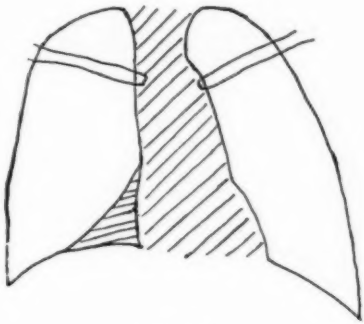

Fig. 58.

with this (SAGEL and RIGLER). In such cases we have found that the wedge-like shadow begins at the hilum but that it does not as a rule extend as far as the thoracic wall.

In all our cases we have found that whether the pneumothorax has appeared alone or been a sequence of pleural drainage the exudate has been perfectly free. Nor in cases of thoracoscopy have we been able to find adhesions of a kind that might explain a possible encapsulation of the exudate. In cases XIV and XVI we also succeeded in showing by Rtg. ex. that this exudate flows out in supine position. The other cases have not been examined in this particular manner. Nor have we been able to demonstrate in three of the cases who succumbed and were examined post-mortem any adhesions whatever that might have explained an encapsulation of the exudate. We have therefore arrived at the definite conclusion that the exudate has been free in all our cases. In the two first cases there was massive collapse of the lower lobes. The first case was verified by autopsy which showed that the presence of a bronchial cancer had occluded the lower main bronchi with subsequent collapse of the lower lobes.

In the three latter cases one found collapse of the upper lobe. The cases also showed the same conditions as regards the exudate as the previous cases although it was not so large. Two of them have been verified by autopsy; in one an occluding cancer was present in the upper main bronchus while the lower lobes were free and contained air. The localisation was the same in the second case although considerable liquefaction of the tumour had taken place here. It was clear, therefore, that there must have existed a communication with the bronchi. Such a communication was also found at the autopsical examination though there was undoubtedly a certain amount of narrowing of the very orifice of the large cavity. There had probably been complete occlusion but the tumour has ulcerated into the bronchus after which liquefaction took place explaining the appearance at the autopsy. It was not a question here of cancer of the bronchus but a squamous cell carcinoma probably formed by metastasis from the uterine cervix. This was probably first laid down in the parenchyma causing compression of the bronchus from outside with subsequent ulceration.

The third case (case XVI) was only incidentally examined by us. The patient is still alive wherefore, naturally, we have been unable, anatomically, to verify the diagnosis. It agrees so well, however, with the previous cases as to exclude any doubt about it. The examination has shown complete collapse of the upper lobe and infiltration in the lower part of the thorax. On examination a month or two earlier this basal infiltration had identically the same appearance as in previous cases. On our examination the basal infiltration had increased con-

siderably and its upper boundary had a more horisontal outline, yet, principally it was of the same appearance. From examination in supine position it is clear that this infiltration, at least partly, was with all probability caused by free exudate as it disperses upwards in the pleural cavity. The now visible high-standing diaphragm favours the possibility of paresis.

In this case one found clinically well-marked broncho-amphoric breathing over the apex of the lung. These breath-sounds were most marked medially, abating towards the lateral side. This favours the possibility of it being conducted from the trachea, displaced towards this side. An explanation that might also quite well fit in with the condition in case XIV where the same type of breathing was present. For in none of these cases was there any evidence of any open bronchus in the massively collapsed area.

How to explain the strange localisation and sharp limitation of the exudate in these cases?

Regarding the factors that determine the location of the ordinary free exudate it is generally held that the weight and the retraction force of the lung are decisive. The capillary force may also conceivably have some influence above all on an exudate of small size. ASSMANN emphasized still another factor namely the relative independence of the separate lobes under the influence of the compression. He also points out that autopsical findings show that in the case of exudate of medium size it is only the lower lobe that is atelectatic whereas the other lobes do not show such a marked reduction of the air-contents. A simple theory is thereby obtained in explanation of the compression of the lower lobe through the exudate rising from below when this retracts towards its point of suspension at the hilum, thereby finding room for the exudate. It must be assumed, therefore, that the spread of the exudate corresponds to the space created by the lower lobe retracted towards the hilum. As the upper and middle lobes together extend further down in front than behind and their lower borders rise from in front and below medially in a spiral fashion round the thorax upwards and backwards, but as the compressed lower lobe, retracted towards the hilum, is situated in the posterior middle parts, one would expect the exudate mainly to gather in the lower posterior and lateral parts of the pleural cavity. There is another factor of definite importance for the lateral increase of the shadow, namely, that in sagittal projection the cloak-like cover of the exudate is obtained in a much greater cross section in the lateral parts than in the medial sections, in which, on the other hand, the corresponding greater cross-section of the air-containing lungs appear illuminated. The gradual transition of these conditions into one another also explains to some extent the ill-defined

contour of the shadow (ASSMANN). The fact that the exudate also compresses the outer parts of the lung thereby causing diminished air-contents in these parts, also brings about a gradual transition from the dense shadow of the exudate to the normal air-containing pulmonary tissue.

The common factor for all our cases with the paradoxical position of the exudate is the presence of a more or less widespread collapse of the lung in addition to the fact that no adhesions have been seen between the pleural layers. In these cases of collapse where we have had the opportunity of measuring the pressure in the pleural sac, we have found, as has already been mentioned, a more or less increased negative pressure.

The altered positions of heart and mediastinum, so typical of collapse, with respiratory pendulum movement, elevation of the diaphragm besides depression of the thoracic wall, changes which are most marked and localised to the area of the collapsed lung, are regarded as an attempt of equalization of the altered pressure conditions in the chest (compare Case IV). It seems most natural to us, therefore, to explain the peculiar position of the exudate in our cases as a result of a similar attempt at equalization of the pressure conditions in the pleural cavity so that the exudate as well as surrounding organs become displaced towards the collapsed area in the lung. Another factor that effects the position of the exudate in these cases similarly to the cases of ordinary free exudates is its weight. In this way we get a displacement of the exudate in different postures and we also obtain an explanation of the otherwise exceedingly strange fact that in our cases of collapse of the upper lobe the exudate has assumed the same position above the diaphragm in sitting posture, as is the case in collapse of the lower lobes.

The peculiar sharp upper limitation of the density we have found to be well marked in the four cases with slight or medium-sized exudate. In the case (case XIII) in which the exudate was larger the limit was more diffuse. In the former cases we think the explanation is that the exudate has collected between the lung and the diaphragm and has an upper surface which is convex from in front backwards. In sagittal projection, therefore, one gets an almost linear contrast between air-containing tissue and exudate. If in addition the lower lobe is also collapsed, as in case XII, the sharp limit will be obtained in the incisura between the lobes. In the case of larger exudates (case XIII) the limit will be ill-defined because in our opinion we get the same phenomenon here with regard to the transition between exudate and lung, as has been described above in regard to ordinary exudates.

This new idea is of interest also from another purely practical aspect. Either the basal opacity has been regarded as a paresis of the diaphragm

or as a tumorous infiltration, surgical treatment has been entirely out of the question. Even in the light of the view advanced here the great majority of cases would seem to be inoperable. Yet operation is not quite out of the question. True that in two of the cases the pleuritic fluid was of a pure exudate type but in the third case the albumin quantity was low (2½ %), thus to some extent an intermediary between exudate and transudation, and in such cases there may be a possibility of resecting the diseased lobe with a view of establishing lasting health for a considerable time. But even in cases of exudate of malignant character operations have been successfully performed. KEY and JACOBÆUS published in 1915 a case of intra-thoracic extra-pulmonary tumour with a bloody exudate with all signs of malignancy where the patient still 15 years after the operation is in perfect health.

Since our manuscript went to the printer we have had the opportunity of observing the following case of massive collapse in connection with tuberculosis.

Case XVII.

I. B., aged 27, shop assistant.

Admitted Aug. 28, 1930.

No family history of any interest. Consulted a doctor in 1926 who found a slight tbc affection of her right apex. She rested for a time and got much better, pat. having ever since been doing a full day's work and felt quite well. Pat. was examined on May 6, 1930 when no changes were found over the left lung. SR 6 mm/hr. Rtg. ex. The two halves of thorax equal. Trachea and upper mediastinum slightly displaced towards the right. Over the right apex there is a slightly diffuse and cloak-like pleural opacity. Within the apical region and in I.1 there is seen a spotty kind of parenchymatous densities, partly calcified, and towards the hilum these formations are continued into a linear kind of peribronchial density. In the left I. 1 and I. 2, laterally, there are one or two thin sharply defined small parenchymatous opacities, arranged in a ball-like fashion (fig. 59).

At the end of July pat. began to feel weak and tired, lost her appetite and developed a little hacking cough. No night-sweats, no rise of temp. On Aug. 8 pat. brought up about a coffee-cupful of fairly dark blood and on the 11th at least a coffee-cupful of similar kind of blood. On the next few days there were a few lumps of clotted blood in the sputa. Temp. lately subfebrile. Slight cough. On examination about a week ago suspected left-sided pneumonia. Has never felt any particular breathlessness on exertion. Moderate emaciation during the last few months.

Condition Aug. 28 slightly impaired. Generalised pallor of skin. Flesh and musculature fairly much reduced. Slight dyspnoea (rate of respiration 30/min.). No cyanosis. Pulse small, soft 100/min. Heart nil. Abdomen nil. Urine nil.

On examination of chest there was medium dullness over the greater part of left lung both in front and behind. Weakened broncho-vesicular breathing over the dull parts and râles of various kinds. On the right side there was slight dullness with râles and vesico-bronchial breathing over the apex as far as C.1 and scapular spine. No sputa. Temp. 37°.5—38°.

Rtg. ex. (fig. 60). A considerable change has taken place since the last examination. The whole of the left half of thorax is depressed, left diaphragm is raised and heart and mediastinum are displaced towards the left. Over the whole of the left lung, particularly in its upper parts, there is a massive opacity through which can be seen small rounded as well as more elongated cavities (probably air-containing ectatic bronchial lumina). The changes in the right lung remain unaltered.

Pneumothorax was induced on Sept. 9.

9/9. — 20 — 13; 500; — 11 — 5.
11/2. — 19 — 10; 500; — 11 — 4.
13/9. — 19 — 9; 500; — 11 — 2.
16/9. — 20 — 6; 500; — 12 — 2.

Rtg. ex. Sept. 29, 30 (fig. 61). Left-sided pneumothorax, lesser amount of exudate filling up the sinus. The lung is found to be well collapsed. Only a couple of thin string-shaped adhesions towards the apical field. In the centre of the pulmonary area some bronchial lumina are seen to contain air.

During the pneumothorax treatment the general condition was rapidly improved. Temp. became quite normal. Increased several kg. in weight.

Commentary. This case is most like case XI of those previously described. Patient has for several years been having a slight chronic tbc. mostly in the right apex which on Rtg. ex. in May 1930 appeared to be healed.

The present illness began insidiously with slight general symptoms. After 1—2 weeks slight haemoptysis. When patient about 3 weeks later came for Rtg. ex. one found an appearance which was then interpreted as a chronic fibrotic tbc-process. Considering this in relation to the previous Rtg. ex. it was clearly a case of massive collapse. The diagnosis was finally verified by induction of pneumothorax.

The collapse is probably, in some way or other, the cause of her pulmonary tbc though through the total absence of sputa its nature can not be definitely ascertained. The collapse is not likely to have been brought about by the slight haemorrhage as it remained for so long afterwards.

The rapid development of bronchiectasis is of the greatest interest and tallies exceedingly well with our previous experience. As was the case in several previous cases with open bronchi in the collapsed area, we have also here broncho-vesicular breathing. This means that it is chiefly the bronchial branches that for some reason or other have become occluded. In evidence of this we have also the dilated air-containing bronchi seen on the roentgenograms.

To Professor Israel Holmgren, Drs. G. Kahlmeter, E. Salén, E. Sahlgren and T. Hafström we desire to express our sincere gratitude for their kindness in placing cases at our disposal.

Our gratitude is also due to the Foundation of »Therese och Johan Anderssons Minne» for financial aid enabling us to carry out and publish this work.

SUMMARY

The authors' continued studies of pulmonary collapse is above all a clinical and roentgenological investigation, the most important results of which will be set out below.

1) Of acute cases of pulmonary collapse the authors describe a further case of haemoptysis, in connection with which they endeavour to elucidate the frequency and the circumstances under which collapse of lung arises in cases of haemoptysis. Out of the 25 cases of haemoptysis observed in the course of 3 years collapse has occurred in 4 cases, mainly in the presence of extensive haemorrhages and a short history.

2) In two cases the acute collapse has appeared as an independent clinical condition in which cases only recurrent bronchitis was present. These cases remind of the postoperative cases of collapse.

3) Of cases of chronic collapse of lung a case is first described in connection with bronchostenosis and bronchiectasis of unknown etiology and with only slight signs and symptoms of collapse.

4) In connection with bronchiectasis the authors have observed 3 cases of collapse of the lung. Of particular interest here is the observation that the bronchial dilatations became aggravated in a short time and that the condition showed signs of progression. The authors consider this due, besides to infections, to the markedly increased negative intrapleural pressure arising in pulmonary collapse, in two of these cases even up to —30 —40 cm. H_2O. The authors have also found pronounced bronchoamphoric breathing over the collapsed areas. They have tried to interpret this phenomenon as due to certain larger bronchi being open and wide while distal bronchial branches have probably to a large extent been occluded by inflammatory changes. In support of this view references are made to experiences from patho-anatomical observations and from roentgenological and bronchoscopic examinations.

5) The authors further describe five cases of collapse of the lung in the presence of chronic pulmonary tuberculosis without haemoptysis. Contrary to the experiences of previous authors the observations in these cases seem to be in favour of a deleterious effect of the collapse upon the development and enlargement of cavities. Great importance is also ascribed here to the markedly increased negative pressure.

6) Five cases are given of lung tumours with partial lobar collapse. Whether the tumours have been localised to an upper or a lower lobe the free exudate, if present, has had a localisaton that has differed from the ordinary one. In all the cases the exudate has had a defined limit from above and medially downwards and laterally. Even here the authors regard the pressure conditions altered on account of the collapse to be the cause.

ZUSAMMENFASSUNG

Die fortgesetzten Studien der Verfasser über Lungenkollaps bestehen vor allem in einer klinischen und röntgenologischen Untersuchung; nachstehend ihre wichtigsten Resultate:

1.) Von akuten Lungenkollapsen wird ein weiterer Hämoptysefall beschrieben; im Anschluss daran versuchen die Verfasser zu untersuchen, in welcher Frequenz und unter welchen Umständen Lungenkollaps bei Hämoptyse auftritt. Unter den 3 Jahre lang beobachteten 25 Fällen mit Hämoptyse war Kollaps in 4 Fällen vorzugsweise bei grossen Blutungen und kurzem Bestehen der Erkrankung aufgetreten.

2.) In 2 Fällen war der akute Lungenkollaps als ein selbständiges Krankenbild aufgetreten, indem von den Brustorganen nur rezidivierende Bronchitis vorgelegen hatte. Der Lungenkollaps erinnert in diesen Fällen in hohem Grade an die postoperativen.

3.) Von chronischen Lungenkollapsen wird zuerst ein Fall mit Bronchostenose unbekannter Ätiologie und nur ubedeutenden lokalen Kollapssymptomen beschrieben.

4.) Im Zusammenhang mit Bronchiektasien beobachteten die Verfasser 3 Fälle von Lungenkollaps. Von besonderem Interesse ist hier die Beobachtung, dass sich die Bronchiektasien in kurzer Zeit vergrösserten, und die Krankheit progrediierte. Nach Ansicht der Verfasser beruht dies ausser auf Infektionen auf dem stark erhöhten negativen intrapleuralen Druck, der bei Lungenkollaps entsteht; — bei zwei von diesen Fällen betrug er bis 30—40 cm H_2O. Die Verfasser fanden ferner ausgesprochene bronchoamphorische Atmung über den kollabierten Gebieten. Sie versuchten dieses Phänomen so zu erklären, dass gewisse Bronchien offen ständen, mit weitem Lumen, während die Zweigbronchien wahrscheinlich in grosser Ausdehnung verstopft waren. Eine Stütze hierfür geben Erfahrungen aus pathologisch-anatomischen Beobachtungen und aus röntgenologischen und bronchoskopischen Untersuchungen.

5.) Die Verfasser beschreiben ferner fünf Fälle von Kollaps bei chronischer Lungentuberkulose ohne Hämoptyse. Im Gegensatz zu den Ansichten früherer Autoren scheinen die Beobachtungen in einem von diesen Fällen für eine deletäre Wirkung des Kollapses durch Entwicklung und Vergrösserung von Kavernen zu sprechen. Dem stark erhöhten negativen Druck wird auch hier wesentliche Bedeutung beigemessen.

6.) Von Lungentumoren mit partiellem lobärem Kollaps werden fünf Fälle beschrieben. Wenn ein freies Exsudat vorlag, hatte es, ob nun die Tumoren im Ober- oder Unterlappen sassen, eine vom gewöhnlichen abweichende Lokalisation. In alien Fällen verlief die Exsudatkontur mit einer Grenze von medial oben nach lateral unten. Auch hier halten die Verfasser die durch den Kollaps veränderten Druckverhältnisse für die Ursache.

RÉSUMÉ

La suite des recherches effectuées par les auteurs sur le collapsus pulmonaire est avant tout une étude clinique et roentgenologique. On en trouvera ci-apres les principaux résultats.

1. Les auteurs décrivent un nouveau cas de collapsus pulmonaire aigu s'accompagnant d'hémoptysies; à cette occasion, ils cherchent à établir la fréquence du collapsus dans les hémoptysies et les conditions dans lesquelles il se produit. Dans les 25 cas observés pendant 3 ans, le collapsus s'est produit de préférence dans les grandes hémorragies et dans des cas d'évolution aiguë.

2. Dans deux cas, le collapsus pulmonaire est apparu comme un tableau nosologique indépendant, ou les seuls signes pulmonaires étaient une bronchite récidivante. Il présente dans ces cas une analogie marquée avec le collapsus postopératoire.

3. En ce qui concerne le collapsus pulmonaire chronique, les auteurs en décrivent d'abord un cas, coïncidant avec une bronchosténose et bronchiectasie d'étiologie inconnue et ne présentant que des signes locaux insignifiants de collapsus.

4. Les auteurs ont observé 3 cas de collapsus pulmonaire s'accompagnant de bronchiectasies. L'une de ces observations présente un intérêt particulier, du fait que les bronchiectasies se sont rapidement étendues et que l'affection a pris un caractère progressif. Les auteurs attribuent cette évolution, non seulement aux phénomènes infectieux, mais aussi à l'augmentation de la pression intra-pleurale négative qui se produit dans le collapsus pulmonaire et qui, dans deux de ces cas, atteignait — 30 et — 40 cm. d'H_2O. Ils ont en outre constaté une respiration broncho-amphorique marquée dans les zones collabescentes; ce phénomène leur paraitrait pouvoir s'expliquer par le fait que certaines bronches restent ouvertes et béantes, tandis que les bronches distales sont vraisemblablement obstruées dans une large mesure. Cette hypothèse est d'ailleurs appuyée par les résultats de l'examen anatomo-pathologique ainsi que par les examens roentgenologiques et bronchoscopiques.

5. Les auteurs décrivent également cinq cas de collapsus au cours d'une tuberculose chronique sans hémoptysie. Contrairement à l'opinion antérieurement émise par certains auteurs, il semble que les observations faites dans l'un de ces cas plaide en faveur de l'action défavorable exercée par le collapsus sur l'évolution et l'augmentation des cavernes. L'augmentation notable de la pression négative aurait ici une signification essentielle.

6. Les auteurs rapportent cinq cas de tumeur pulmonaire avec collapsus lobaire partiel. Que les tumeurs siègent dans le lobe supérieur ou dans le lobe inférieur, l'exsudat libre affectait, lorsqu'il existait, une localisation différente de la localisation habituelle. Dans tous les cas, la limite de l'exsudat s'étendait avec une délimitation, de haut en bas en suivant la ligne médiane avec inflexion latérale. Ici aussi les auteurs estiment que les phénomènes observés doivent être attribués à la modification produite par le collapsus dans les conditions de pression.

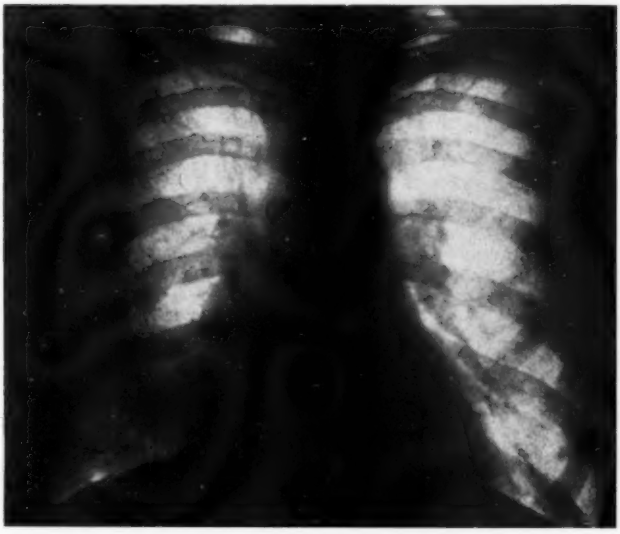

Fig. 1. Case I. $^{28}/_{9}$ 28. Partial collapse of the right lower lobe.

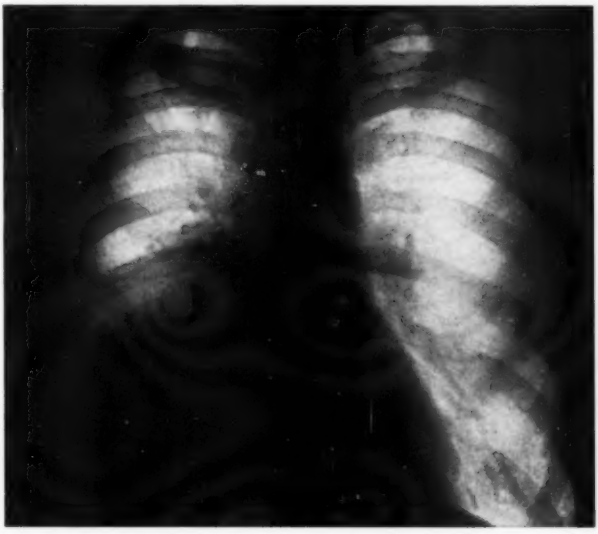

Fig. 2. Case I. $^{2}/_{10}$ 28. Increase of the collapse of the right lower lobe.

Fig. 3. Case I. $^{11}/_{10}$ 28. No collapse.

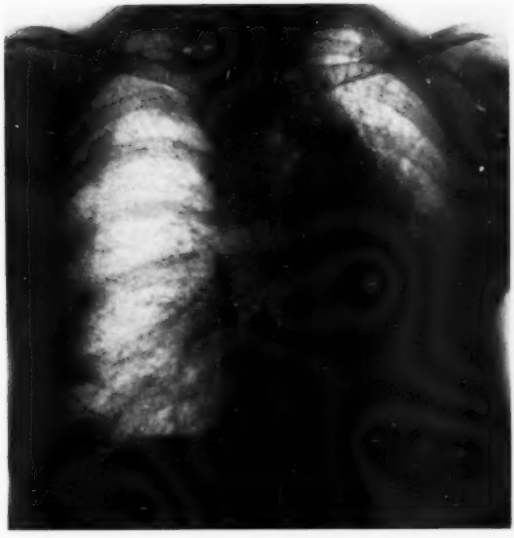

Fig. 4. Case II. $^{21}/_{11}$ 28. Massive collapse of the left lower lobe.

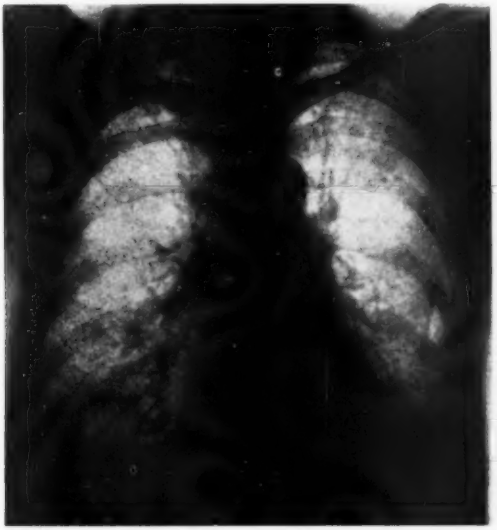

Fig. 5. Case II. $^{12}/_{12}$ 28. No collapse.

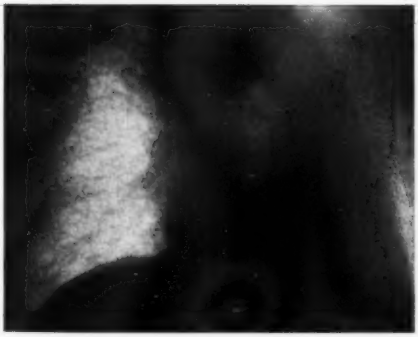

Fig. 6. Case III. $^{5}/_{2}$ 29. Massive collapse of the left lung.

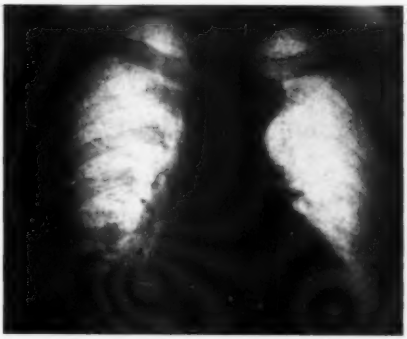

Fig. 7. Case III. $^{3}/_{4}$ 29. No collapse.

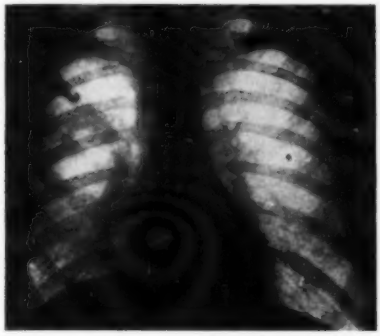

Fig. 8. Case IV. $^{15}/_{3}$ 30. Inspirium.

Fig. 9. Case IV. $^{15}/_{3}$ 30. Exspirium.

Fig. 8 and 9 show a respiratory movement of heart and mediastinum. Partial collapse of the right lower lobe. Expiratory emphysema of the middle part of the right lung.

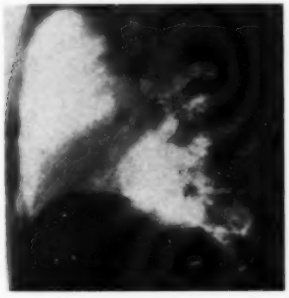

Fig. 10. Case IV. $^{15}/_{3}$ 30. Inspirium.

Fig. 11. Case IV. $^{15}/_{3}$ 30. Exspirium.

Fig. 10 and 11 show that the anterior part of the diaphragm does not move during respiration.

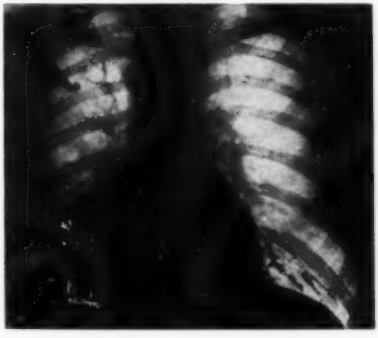

Fig. 12. Case IV. $^{22}/_{1}$ 30.

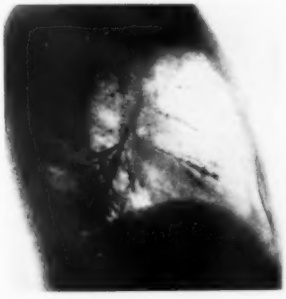

Fig. 13. Case IV. $^{22}/_{1}$ 30.

Fig. 12 and 13. Lipiodol-injection into the right lung. Marked stenosis of the anterior lower main bronchus.

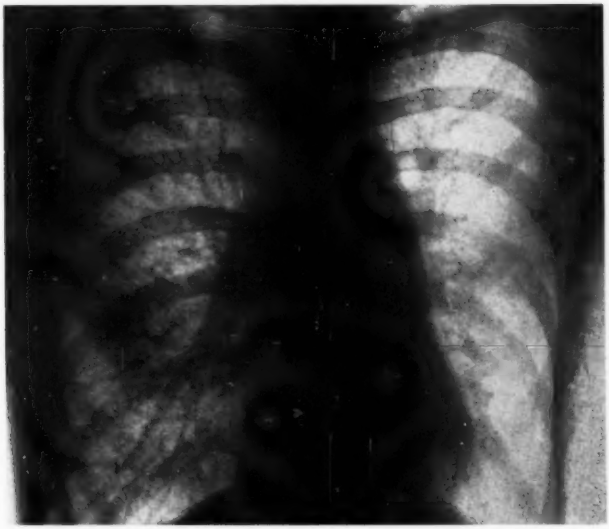

Fig. 14. Case V. $^{16}/_{12}$ 29. Bronchiectases on both sides, particularly to the left. Marked emphysema on left side.

Fig. 15. Case V. $^{7}/_{1}$ 30. Massive collapse of the left lower lobe has appeared since last examination.

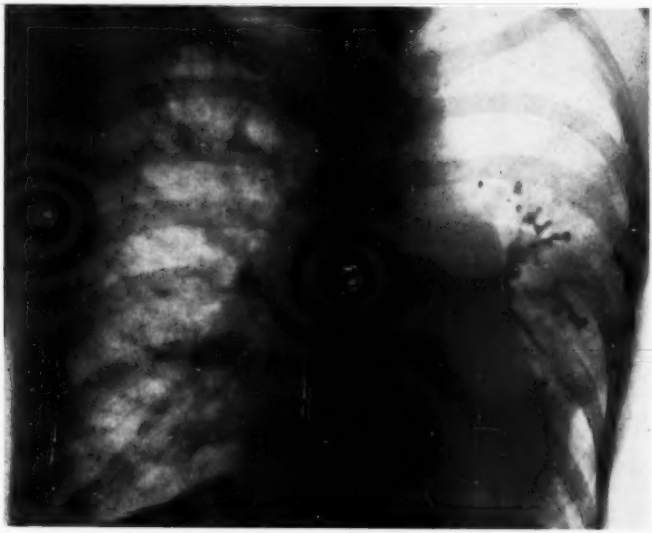

Fig. 16. Case V. $^{10}/_{1}$ 30. Lipiodol-injection into the left lung.

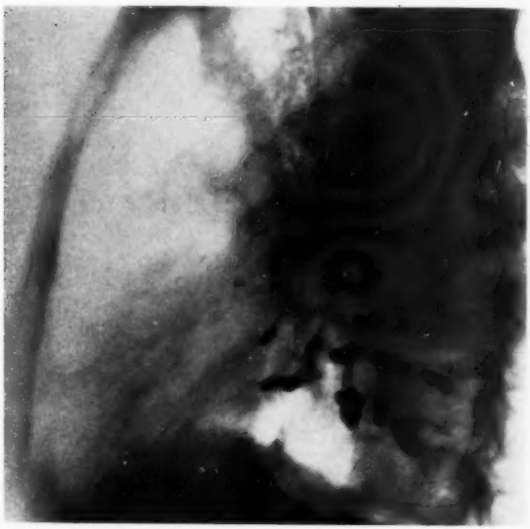

Fig. 17. Case V. $^{10}/_{1}$ 30. Lipiodol-injection into the left lung. Extensive bronchiectases of the left bronchi.

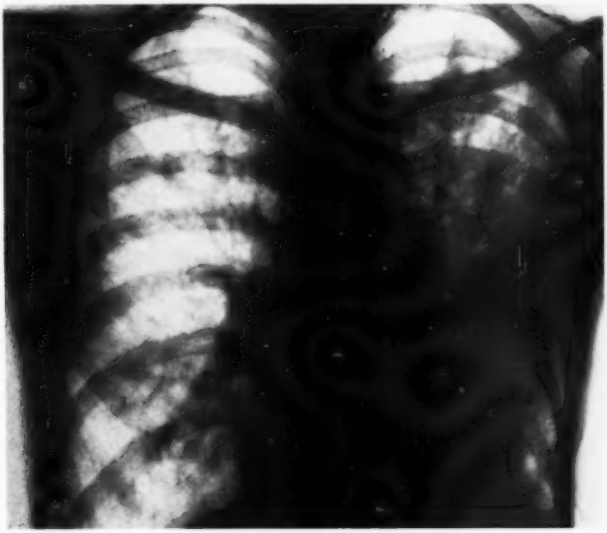

Fig. 18. Case V. $^{11}/_{1}$ 30. The massive collapse has decreased since last examination.

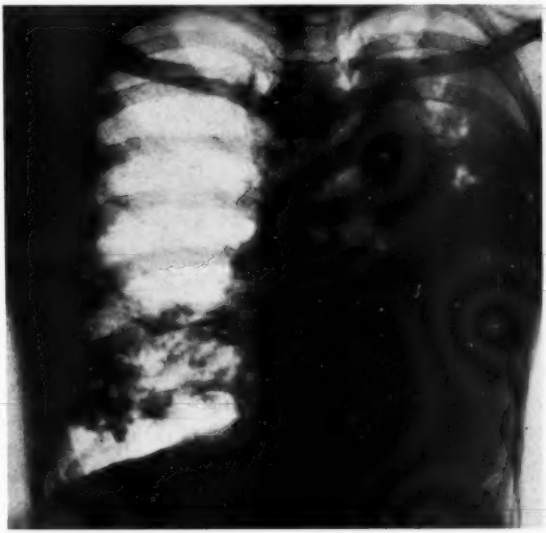

Fig. 19. Case V. $^{15}/_{3}$ 30. The massive collapse has again increased. The bronchiectases are enlarged.

Fig. 20. Case V. $^{19}/_{8}$ 30. Lipiodol-injection into the left lung.

Fig. 21. Case V. $^{19}/_{8}$ 30. Lipiodol-injection into the left lung. The bronchiectases are considerably enlarged.

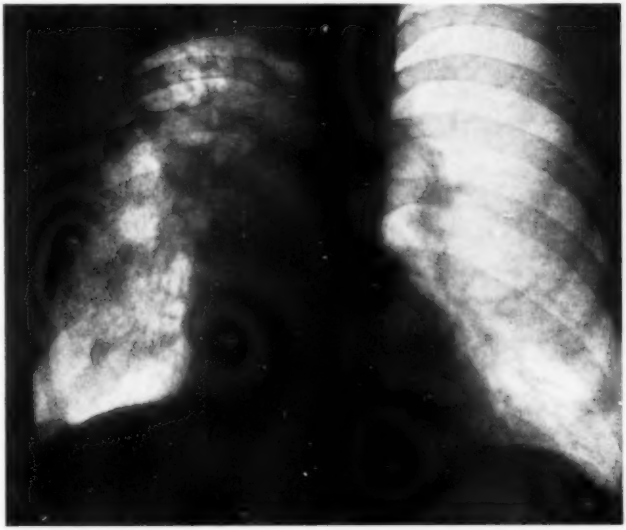

Fig. 22. Case VI. 7/6 30. Extensive bronchiectatic cavities of the right lung.

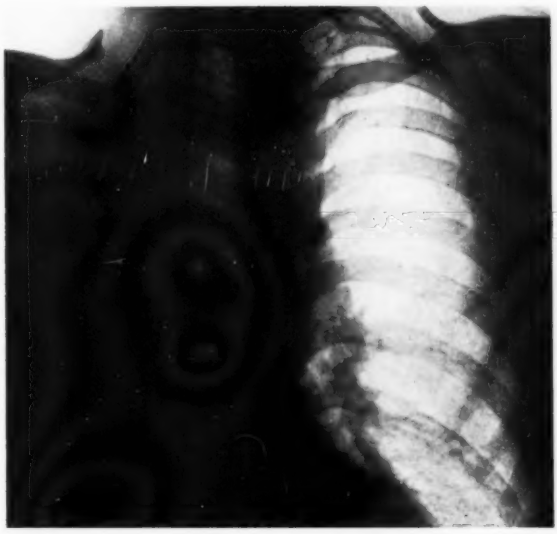

Fig. 23. Case VI. 21/6 30. Massive collapse of the right lung has appeared since last examination.

Fig. 24. Case VII. $^{14}/_{4}$ 30. Massive collapse of the right lung.

Fig. 25. Case VII. $^{12}/_{5}$ 30. This figure is more exposed than the former. Bronchiectatic cavities are visible.

Fig. 26. Case VII. 13/5 30. Lipiodol-injection into the right lung. Large bronchiectatic cavities.

Fig. 27. Case VII. 21/5 30. The bronchiectatic cavities are considerably enlarged since the former examination 13/5 30.

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Fig. 28. Case VIII. 9/9 29. Inspirium.

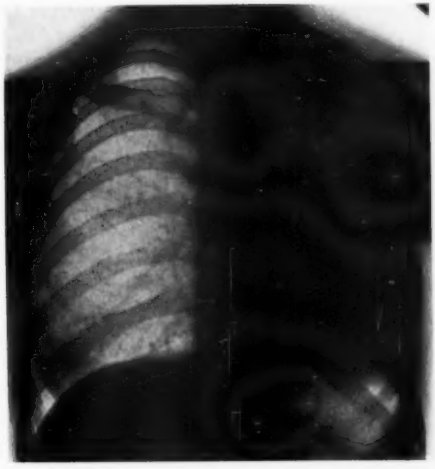

Fig. 29. Case VIII. 9/9 29. Exspirium.

Fig. 28 and 29 show a massive collapse of the left lung. Respiratory movement of heart and mediastinum.

Fig. 30. Case IX. 17/9 30. Massive density of the upper and middle parts of the left lung. Large cavities in apex and down to the third rib.

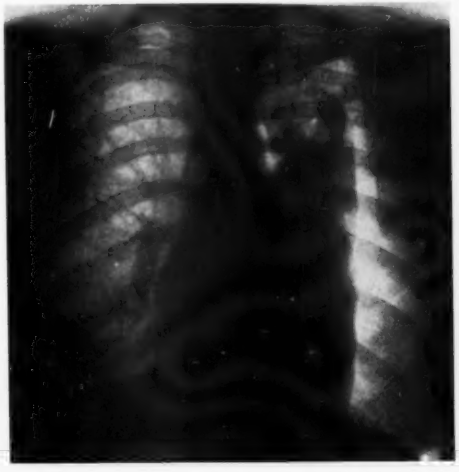

Fig. 31. Case IX. 23/9 30. Left-sided pneumothorax. Left lung collapsed. Only adhesions in apex.

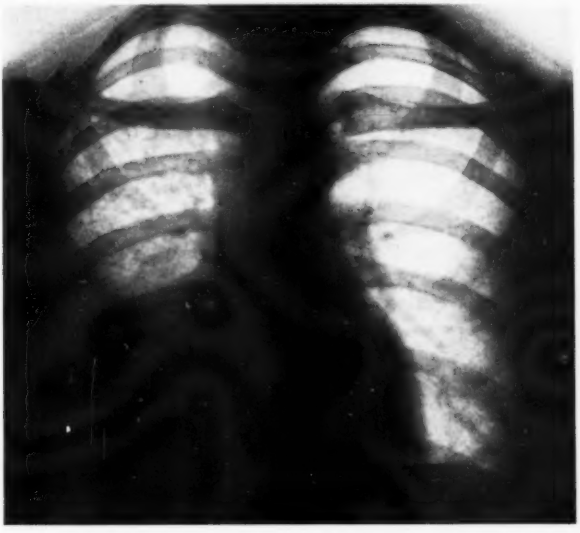

Fig. 32. Case X. $^{5}/_{1}$ 28. Massive collapse of the right lower lobe. Tbc-process of the upper lobes.

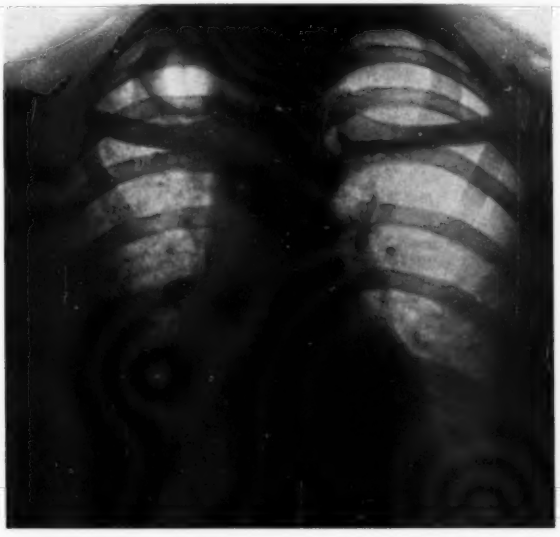

Fig. 33. Case X. $^{6}/_{10}$ 28. The massive collapse unchanged. A large thin-walled cavity in the apex.

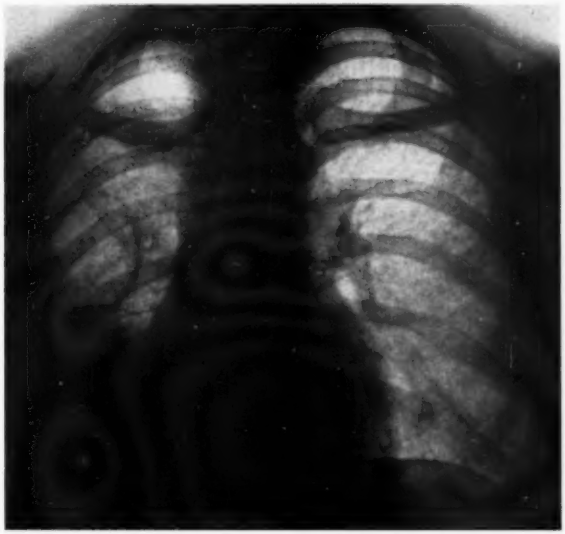

Fig. 34. Case X. $^{3}/_{1}$ 30. The massive collapse is unchanged. Three thin-walled and roundshaped cavities have appeared. No reaction in the surroundings.

Fig. 35. Case X. $^{13}/_{2}$ 30.

Fig. 36. Case X. $^{13}/_{9}$ 30.

Fig. 35 and 36 show a right-sided pneumothorax. The lower lobe is collapsed. In all lobes thin-walled cavities.

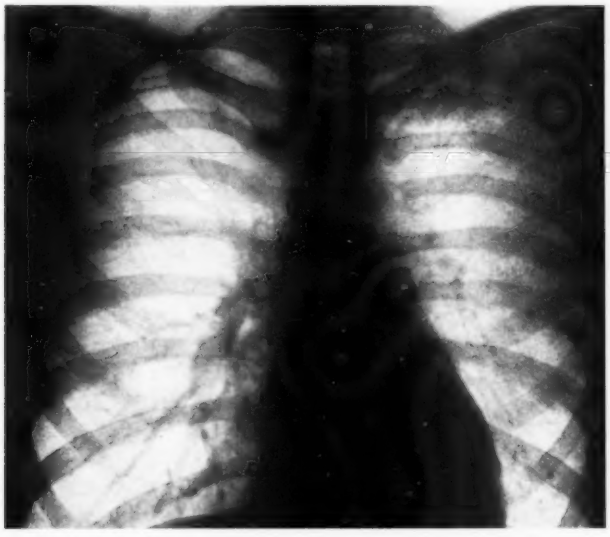

Fig. 37. Case XI. $^{24}/_{8}$ 30. Chronic tbc-process in the left upper lobe.

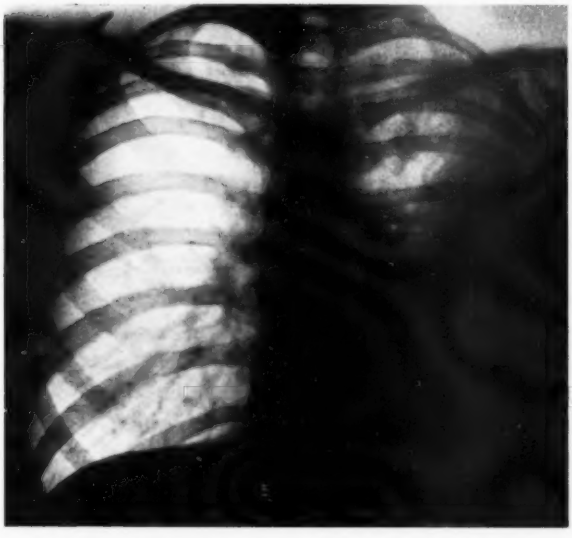

Fig. 38. Case XI. $^{2}/_{7}$ 30. Massive collapse of the lower left lobe has appeared.

Fig. 39. Case XII. $^{7}/_{1}$ 28. Note the sharp-bounded massive density filling out the heart-phrenical angle. The upper line of demarcation is going from above medial down- and lateralwards to the thorax wall.

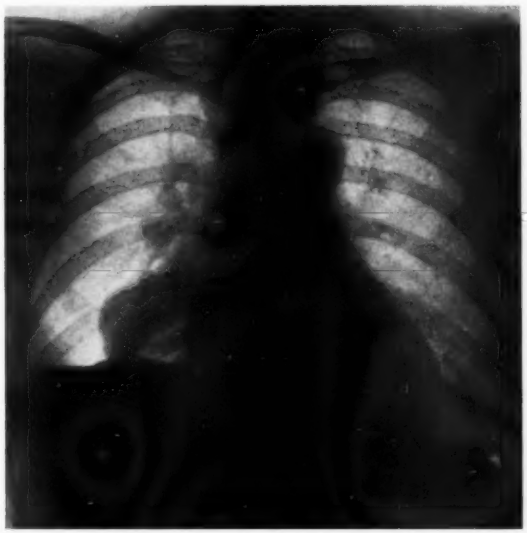

Fig. 40. Case XII. $^{17}/_{1}$ 28. Right-sided pneumothorax with free exudate. The lower lobes are completely collapsed. The upper is filled with air.

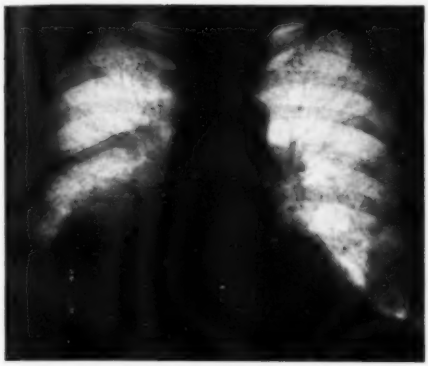

Fig. 41. Case XIII. $^{4}/_{1}$ 30. Upright position. Note the density filling out the heart-phrenical angle on right side. The line of demarcation is going from above medial down- and lateralwards to the thorax wall.

Fig. 42. Case XIII. $^{4}/_{1}$ 30. Supine position. The marked density filling out the heart-phrenical angle in upright position is mostly disappeared. Now there is a moderate density over the entire right lung. Free exudate.

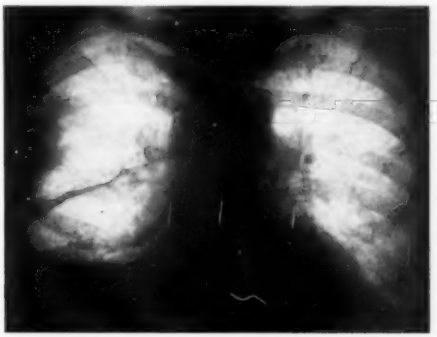

Fig. 43. Case XIII. $^{9}/_{1}$ 30. Right-sided pneumothorax. Free exudate.

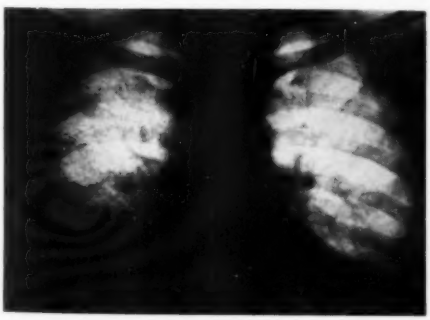

Fig. 44. Case XIII. $^{28}/_{1}$ 30. Upright position. No pneumothorax. The exudate on the right side has a similar position as in fig. 41. On the left side an exudate showing usual position.

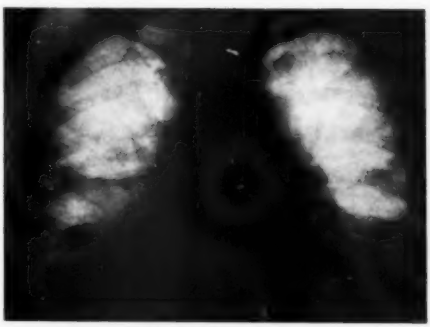

Fig. 45. Case XIII. $^{28}/_{1}$ 30. Supine position. The exudate on both sides have swimmed out over the entire lungs.

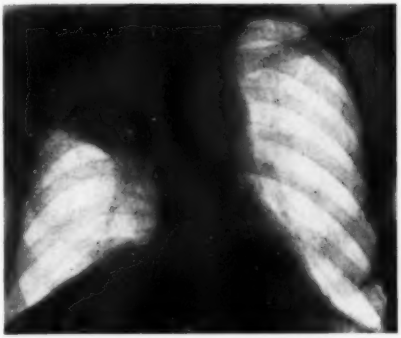

Fig. 46. Case XIV. $^{24}/_{10}$ 29. A massive lobar density of the upper lobe. Note the density filling out the heart-phrenical angle on the right side. The line of demarcation is going from above medial down- and lateralwards to the thorax wall.

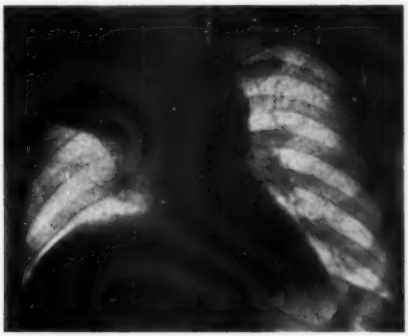

Fig. 47. Case XIV. $^{30}/_{11}$ 29. The lower density is larger. The line of demarcation is more curved upwards but has the same direction as earlier.

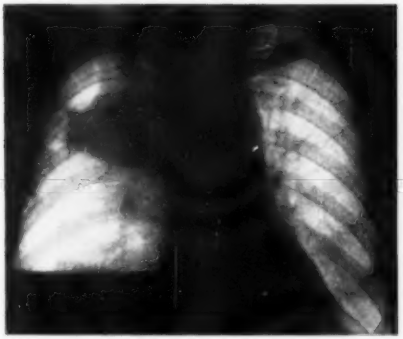

Fig. 48. Case XIV. $^{20}/_{12}$ 29. Right-sided pneumothorax. Free exudate. The upper lobe is collapsed. The two lower are air-filled.

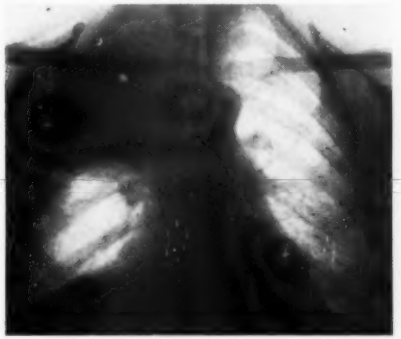

Fig. 49. Case XV. $^{9}/_{4}$ 30. A massive lobar density on the right side. Note the density filling out the heart-phrenical angle on the right side. The line of demarcation is going from above medial down- and lateralwards to the thorax wall.

Fig. 50. Case XV. $^{29}/_{5}$ 30. A large cavity has appeared in the upper lobe. In other respects unchanged.

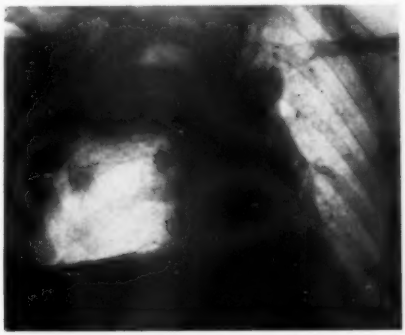

Fig. 51. Case XV. $^{23}/_{5}$ 30. Right-sided pneumothorax. Free exudate. The upper lobe is collapsed and a large cavity is visible in this lobe.

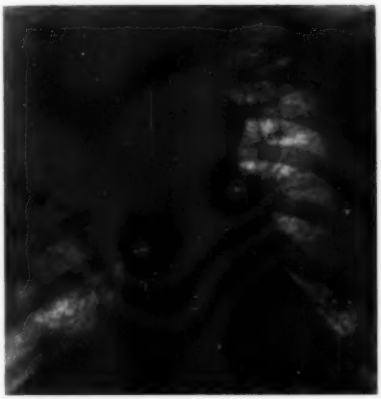

Fig. 52. Case XVI. $^{2}/_{10}$ 30. A massive lobar density of the upper lobe. Note the density filling out the heart-phrenical angle on the right side. The line of demarcation is going from above medial down- and lateralwards to the thorax wall.

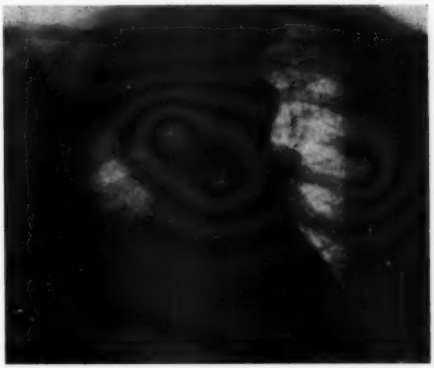

Fig. 53. Case XVI. $^{2}/_{10}$ 30. Upright position. The upper lobar density unchanged. The basal density has increased. Diaphragm more elevated.

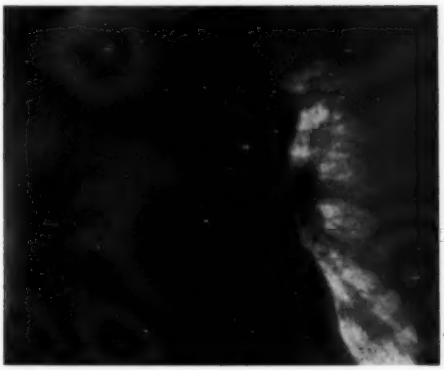

Fig. 54. Case XVI. $^{2}/_{10}$ 30. Supine position. The basal exudate has swimmed out over the entire lung.

Fig. 59. Case XVII. $^{6}/_{5}$ 1930. Showing a fibrous tbc process in right apex and in left I. 2. No collapse.

Fig. 60. Case XVII. $^{29}/_{5}$ 1930. Left-sided massive collapse. Note the bronchiectases in the upper lobe.

Fig. 61. Case XVII. $^{29}/_{9}$ 1930. Left-sided pneumothorax. Small exudate. Lung completely collapsed and free except a thin adhesion of apex.

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(AUS DER PATHOLOGISCHEN ABTEILUNG DES KRANKENHAUSES SABBATSBERG, STOCKHOLM. PROF. H. BERGSTRAND)

ÜBER EINE EIGENARTIGE, WAHRSCHEINLICH BISHER NICHT BESCHRIEBENE OSTEOBLASTISCHE KRANKHEIT IN DEN LANGEN KNOCHEN DER HAND UND DES FUSSES

von

Hilding Bergstrand

1. Einleitung

Die im folgenden beschriebenen beiden Krankheitsfälle scheinen ein charakteristisches Krankheitsbild darzubieten, das bisher vielleicht noch nicht beachtet und deshalb einer Veröffentlichung wert sein dürfte.

In beiden Fällen handelte es sich um eine im Fusse resp. der Hand langsam auftretende Auftreibung eines der langen Knochen, verbunden mit Schwellung und Schmerzen, die den Patienten dazu zwangen, einen Arzt aufzusuchen. Die Röntgenaufnahme zeigte eine Verdickung des Knochens, und durch den breiten Schatten schimmerte die Kortikalis an der gewöhnlichen Stelle durch. Im einen Falle sah man subkapitular einen rundlichen Verdünnungsherd. Da das Röntgenbild Verdacht auf ein osteoblastisches Sarkom erweckte, wurden die Patienten operiert, wobei man im einen Falle Resektion, im anderen Exartikulation machte. Danach wurden die Patienten vollständig gesund und bekamen kein Rezidiv.

Die anatomische Untersuchung zeigte, dass es sich hier weder um ein Tumorgebilde, noch um einen entzündlichen Prozess, sondern um einen Wachstumsprozess anderer Art handelte, dessen Zentrum in dem obenerwähnten Herde lag.

2. Klinische Beschreibung der Fälle

Fall 1. 16-jähriges Mädchen. Kellnerin. Die Patientin wurde das erste Mal am 11. XII. 1919 in das Krankenhaus aufgenommen. Sie gab an, zwischen ihrem 3. und 13. Lebensjahre an einem schwereren Augenleiden gelitten zu haben (Keratitis parenchymatosa). Zwei Monate vor der Aufnahme hatte der rechte Fuss zu schwellen begonnen. Von einem Trauma ist ihr nichts bekannt. Trotzdem die Patientin sich ruhig ver-

Fig. 1. Röntgenbild des rechten Fusses mit dem krankhaft veränderten Os metatarsale II. Fall 1.

hielt, trat keine Besserung ein. Bei der Untersuchung am 15. XII. konstatierte man einen stark ausgesprochenen doppelseitigen Pes planovalgus. Am rechten Fusse sah man eine spindelförmige Auftreibung des Os metatarsale II. Starke Empfindlichkeit über diesem Knochen. Geringe Schwellung in der Umgebung. Keine Rötung. Die Röntgenuntersuchung (Dr M. Simon) ergab folgendes:

»Die ganze Diaphyse des 2. Metatarsalknochens zeigt eine unregelmässige Verdickung, am stärksten in der proximalen Hälfte, wo die Breite des Knochens ungefähr 13 mm erreicht. Durch diesen breiten Schatten sieht man die Kortikalis deutlich mit etwas breiteren Streifen als gewöhnlich durchschimmern. Ausserhalb von diesem Kortikalisschatten ist die Auflagerung dicht homogen. Ihre äusseren Konturen gleichmässig, aber etwas ausgebuchtet (siehe Fig. 1).» Am 19. XII. wurde eine neuerliche Röntgenuntersuchung vorgenommen, die dasselbe Resultat ergab. Die Hornhautveränderungen wurden von einem Spezialisten untersucht, der sich folgendermassen äusserte: »Hornhauttrübungen von phlyktänulärem Typus. Keine Augenhintergrundveränderungen. Also keine Zeichen

einer hederitären Lues». Am 19. XII. wurde die Patientin unter Verordnung einer Jodkaliummedikation nach Hause geschickt, der Zustand besserte sich aber nicht, und sie musste wegen Schwellung und Schmerzen im Fuss, die nachts besonders heftig waren, zu Bett liegen.

Bei der nächsten Aufnahme (24. I. 1921) wies die Patientin einen guten Allgemeinzustand auf und hatte kein Fieber. Am medialen Teil des rechten Mittelfusses ist noch immer eine diffus begrenzte Schwellung zu beobachten. Die Haut über der Anschwellung ist auch etwas an die Unterlage fixiert. Diese wird vom spindelförmig aufgetriebenen 2. Metatarsalknochen gebildet. Starke direkte und schwächere indirekte Empfindlichkeit über diesem Knochen. Die Weichteilsschwellung fest und hart, greift auf das Metatarsale III über. An der Fussohle keine augenfällige Schwellung oder Empfindlichkeit. Pat. kann sich nur schwer auf den Fuss stützen.

Am 28. I. wurde die ganze Diaphyse des Metatarsale II reseziert. An Stelle des resezierten Knochenstückes wurde eine Tibiaspange eingelegt (Prof. NYSTRÖM). Am 19. II. wurde Pat. entlassen und konnte damals auf Krücken umhergehen. Sie wurde dann bald frei von allen Beschwerden, und weiterhin war nichts mehr von ihr zu hören.

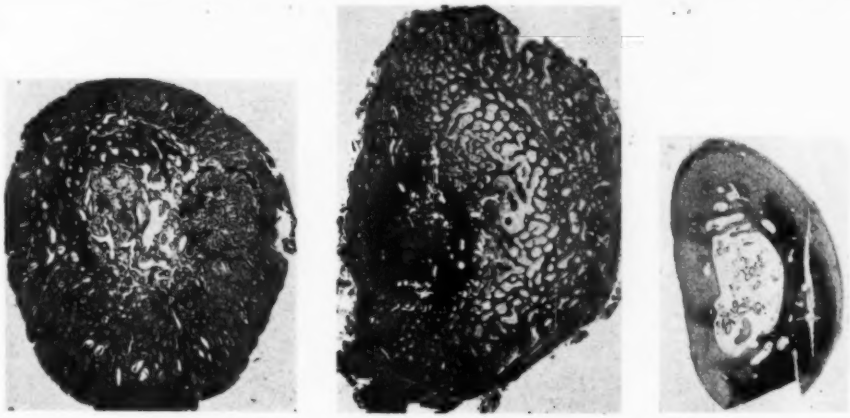
Fall 2. 18-jähriger junger Mann, Chauffeur. Der Patient hatte bei der Untersuchung am 16. VII. 1927 seit 2 Jahren eine zunehmende Auftreibung des linken Mittelfingers. Eine Ursache für diese Auftreibung ist ihm nicht bekannt. Bei der am selben Tage vorgenommenen Röntgenuntersuchung (Dr S. LINDBLOM) ergab sich folgendes.

Röntgenbefund: »Die Basalphalange des linken Mittelfingers zeigt in der distalen Hälfte der Diaphyse eine vollständig zerstörte Knochenzeichnung: Die Knochenbalken sind unregelmässig und dicht, und subkapital tritt eine rundliche Verdünnung mit zwiebelförmig angeordneten Knochenbalken hervor. Ausserdem besteht eine unregelmässige und ziemlich dichte Knochenauflagerung mit spikulaähnlicher Kontur . . . Osteosarkom». Die Platten, auf die sich dieses Gutachten stützt, sind leider abhandengekommen.

Am folgenden Tage wurde der Patient operiert, und der obenerwähnte Finger exartikuliert (Dr ODELBERG). Die Heilung ging rasch vor sich, und im Juni 1930, als Verf. bei dem Patienten anfragte, befand dieser sich vollständig gesund und hatte von seiner linken Hand keine Beschwerden mehr gehabt.

3. Anatomische Untersuchung

Die Untersuchung der Operationspräparate zeigte in den beiden oben beschriebenen Fällen vollständig identische Veränderungen, weshalb sie zweckmässigerweise gleichzeitig beschrieben werden können.



a b c

Fig. 2. Querschnitte a) vom Os metatarsale II im Fall 1 und b) von der Grundphalange des Mittelfingers im Fall 2. Der für den krankhaften Prozess charakteristische Herd in ihrem Zentrum ist auf Fig. a schlecht zu sehen, weshalb er mit einer gestrichelten Linie umgrenzt ist. Auf Fig. b sieht man den eben erwähnten Herd hingegen deutlich. Fig. c ist ein Querschnitt des normalen Os metatarsale II einer 20jährigen Frau, der hier zum Vergleich abgebildet ist.

Querschnitte durch die verdickten Knochen zeigen, dass deren Volumen wesentlich zugenommen hatte. Dies geht aus Fig. 2 hervor, die Querschnitte der Knochen von beiden Fällen und zum Vergleich den Querschnitt des 2. Metatarsalknochens einer 20-jährigen Frau zeigt. Aus der Figur geht ferner hervor, dass auch die Markhöhle verschwunden ist, und ihr Platz von einem grobporigen Knochen eingenommen wird, der mit der Kortikalis zusammenhängt, die ihrerseits so verwandelt ist, dass ihre Knochensubstanz dasselbe grobporige Aussehen hat wie der neugebildete Knochen in der Markhöhle. Im mikroskopischen Schnitt ist die Kortikalis nicht zu unterscheiden, im Gegensatz zum Röntgenbilde, wo man noch die Andeutung eines Kortikalisschattens merken kann. Die äussere Kontur des Knochens sieht bei Lupenvergrösserung nicht vollständig glatt aus, sondern gleichsam gezähnt. Offenbar sind es diese Bilder, die bei dem einen Röntgenbefund Anlass zur Angabe »Spikulakontur» gaben.

In dem Knochengewebe ist ein exzentrisch liegender, rundlicher, klein-Erbsen-grosser Herd zu beobachten. Dieser Herd hat auf dem Querschnitt des formalinfixierten Knochens ein dunkelgefärbtes Aussehen. Der Herd ist auf dem geschnittenen Paraffinblock zu sehen, und in den mikroskopischen Schnitten hebt er sich deutlich von der Umgebung ab. Dieser Herd liegt im Falle 1, wo es sich um einen Metatarsalknochen handelt, im proximalen Teil der Diaphyse. Im Falle 2 dagegen, wo es sich um die

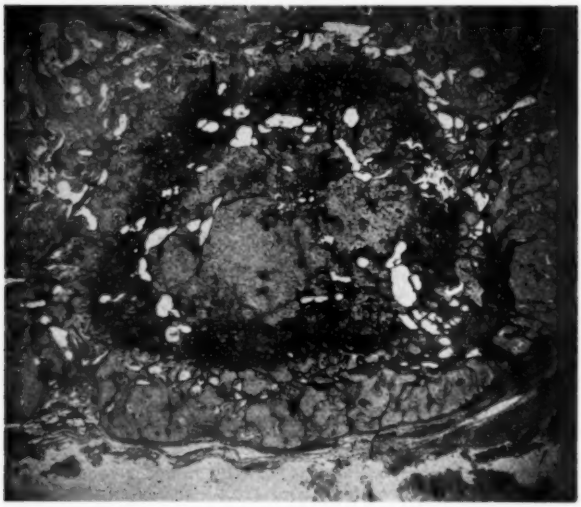


Fig. 3. Der auf Fig. 2 b sichtbare Herd in stärkerer Vergrösserung. Haem.-Eosin. Das Zentrum des Herdes ist von einer amorphen, homogenen Masse eingenommen, die von einer breiten Zone eines blutgefässreichen und von dünnen, neugebildeten Knochenbalken durchzogenen Gewebes umgeben ist. Der Herd liegt exzentrisch in der Phalange, und an ein paar Stellen sieht man Defekte in der äusseren Schicht sowie eine Kommunikation zwischen der eben erwähnten gefässreichen Zone und dem Periost.

Grundphalange des einen Mittelfingers handelt, liegt der Herd im distalen Teil der Diaphyse. Die Verdickung des Knochens ist in Übereinstimmung hiermit bei dem einen Falle im proximalen Ende, beim anderen im distalen am stärksten (siehe Fig. 1).

Das Zentrum des obenerwähnten Herdes besteht aus einer amorphen, kollagenen, bei Malloryfärbung blaugefärbten Masse (siehe Fig. 2 und 3). Diese strukturlose Masse ist peripher von einer ziemlich breiten Zone eines blutgefässreichen, von dünnen neugebildeten Knochenbalken durchgezogenen Gewebes umgeben. Von dieser Zone — auf Abb. 3 tritt sie deutlich hervor — dringen zahlreiche dünnwandige Gefässe in die homogene Masse gegen deren Zentrum hinein, das jedoch so gut wie frei von Gefässen ist. Diese Gefässe sind teils eng, kapillär, teils weit, sinuös. Zwischen dem Lumen des Gefässes und der amorphen Masse sieht man grosse, protoplasmareiche, unregelmässig geformte Zellen mit einem grossen, blasenförmigen Kern. Das Protoplasma dieser Zellen nimmt bei Hämatoxylin-Eosinfärbung einen dunklen Ton an, und bei Plasmazellenfärbung tritt sein basophiler Charakter noch deutlicher hervor. Ob diese Zellen Endothelzellen in den Gefässen sind, oder ob sie ausserhalb der Gefässwand liegen, lässt sich nicht bestimmt entscheiden. Jedenfalls

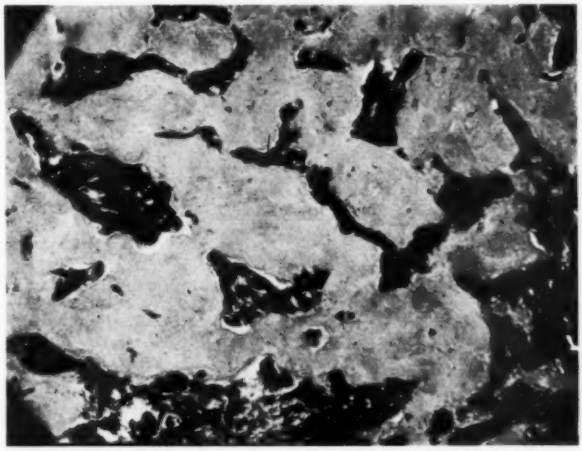


Fig. 4. Haem.-Eosin. Bild von der Peripherie der homogenen Masse, in welche aus der sie umgebenden gefässreichen Zone mit Blutkörperchen vollgepfropfte Gefässe eindringen. In den Wänden der Gefässe grosse, protoplasmareiche, basophile Zellen mit blasenförmigem Kern.

machen die Bilder in den zentraleren Teilen des Herdes den Eindruck, dass die Zellen die Wände der Gefässe bilden. Die Form der Zellen ist verschieden, einige sind rund, andere wiederum mit ziemlich groben Fortsätzen versehen. Es handelt sich hier offenbar um Zellen vom selben Typus, wie die im embryonalen Knochengewebe vorhandenen Zellen, die man dort als Osteoblasten auffasst. Die hier beschriebenen Bilder sind auf Fig. 4 zu finden, infolge des basophilen Charakters des Protoplasmas aber heben sich die Kerne nicht deutlich vom Protoplasma ab.

Wenn man von den die Gefässe begleitenden grossen, basophilen Zellen absieht, ist die amorphe Masse äusserst zellarm. Höchstens sieht man undeutliche Reste von Zellen, die aussehen, als wenn sie in Hohlräumen gelegen hätten.

Die amorphe Masse splittert sich nach aussen zur Peripherie hin immer mehr in Balken auf, die von einer Reihe der obenerwähnten grossen, als Osteoblasten aufgefassten Zellen bekleidet sind.

Eine Andeutung von einer solchen Balkenbildung ist auf Fig. 4 zu sehen. Allmählich bilden sich auf diese Weise wirkliche Balken, die durch Verkalkung in Knochen verwandelt werden. Ausgeprägt tritt dies in der mehrfach erwähnten, gefässreichen, die amorphe Masse umgebenden Zone hervor. Die basophilen Zellen sind hier zahlreicher und liegen frei von den Gefässen, von welchen sie durch ein lockeres Bindegewebe geschieden sind. Bezüglich ihrer Anordnung um die Balken gleichen die basophilen Zellen vollständig Osteoblasten, und sie sind auch in Form

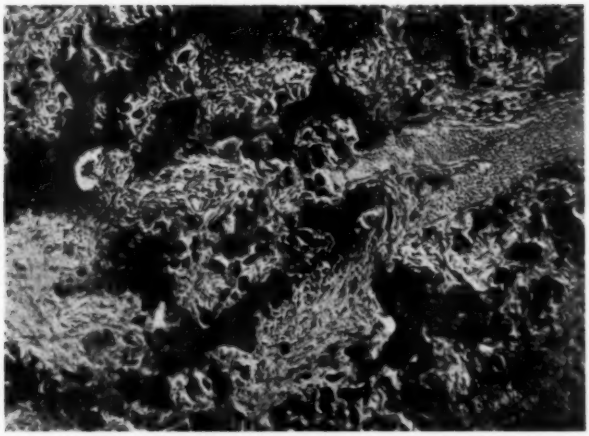


Fig. 5. Haem.-v. Gieson. Das Bild zeigt ein Stück der gefässreichen Zone mit ihren aus der homogenen, zentralen Masse gebildeten Knochenbalken, die von basophilen Zellen umgeben sind.

von Knochenkörperchen in die Knochenbalken eingeschlossen. Diese Knochenkörperchen sind arm an Protoplasma und nicht von Kapillaren begleitet. Fig. 5 gibt eine Vorstellung von all dem, was hier geschildert ist.

In dieser Zone findet sich indes auch eine andere Art Zellen mit zahlreichen Kernen. Sie liegen in »Howshipschen Lakunen» in den neugebildeten Knochenbalken und zeigen alle Charakteristika, die den sogenannten Osteoklasten zukommen. (Siehe Fig. 6.)

Schon in der zentralen amorphen Masse wurden, wie oben angedeutet, kleinere, unregelmässig geformte, ziemlich scharf begrenzte, schwach verkalkte Gebiete angetroffen. Jedes solche Gebiet weist in der Mitte ein Gefäss auf, und man bekommt dadurch den Eindruck, dass Gefäss und Verkalkungsgebiet miteinander in Zusammenhang stehen. An manchen Stellen liegen solche Verkalkungsgebiete dicht aneinander, und man erhält dann Bilder, die an die Brecciazeichnung in normalem Knochen erinnern. Vollständig wird die Verkalkung erst in den Balken der gefässreichen Zone. Die Grenze zwischen dieser Zone und dem angrenzenden Knochen ist insofern unscharf, als die Knochenbalken im letzteren kontinuierlich in die Knochenbalken der ersteren übergehen. Anderseits besteht die grobporige Kompakta aus lamellärem Knochen, während der Knochen in der gefässreichen Zone keine Lamellen aufweist. Die Grenze zwischen den verschiedenen Knochenarten sieht man im allgemeinen recht deutlich, wie aus Fig. 7 hervorgeht, die ein Stück des Grenzgebietes zwischen der grobporigen Kompakta und dem zentralen Herde abbildet.

Der hier beschriebene Herd liegt, wie schon oben angeführt ist, exzen-

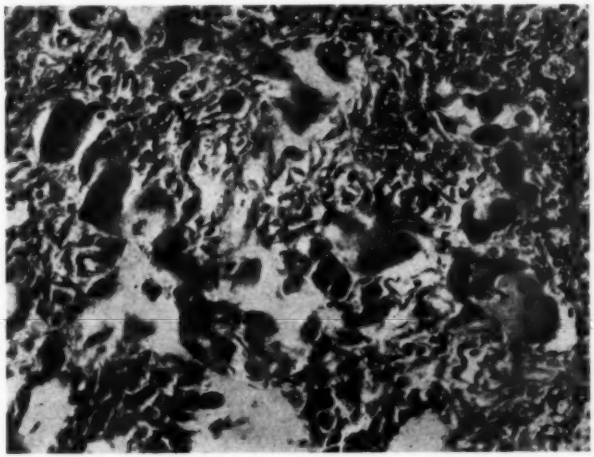


Fig. 6. Osteoklasten, die in Howshipschen Lakunen in den neugebildeten Knochenbalken der gefässreichen Zone liegen.

trisch; der ihn umgebende grobporige Knochen ist deshalb von verschiedener Dicke. Im Falle 2 besteht der Knochen auf der einen Seite nur aus einer dünnen Schale, die ausserdem an ein paar Stellen breit durchbrochen ist, so dass ein weiter, von lockerem Bindegewebe angefüllter Kanal gebildet ist.

In der Kompakta sind die Haversischen Kanäle in Haversische Räume verwandelt, die von einem lockeren Bindegewebe erfüllt sind (»fibröses Markgewebe»). Sie sind von einer Reihe grosser, protoplasmareicher Zellen ausgekleidet, ähnlich denen, die sich im zentralen Herde finden, ohne aber deren Grösse zu erreichen. Hier und da finden sich Howshipsche Lakunen und mehrkernige Zellen, sog. Osteoklasten, sie sind aber nicht zahlreich. Zwischen der Zellauskleidung und dem verkalkten Knochen sieht man in den Haversischen Räumen eine Zone von Knochen, der in Präparaten, die mit Hämatoxylin-Eosin gefärbt sind, einen roten Farbton annimmt, der also offenbar keinen Kalk enthält. Ein Teil der noch erhalten gebliebenen Haversischen Kanäle, auch solche mit dem allerfeinsten Lumen, sind mit den oben beschriebenen, protoplasmareichen Zellen angefüllt, und die Knochensubstanz in ihrer nächsten Umgebung enthält keinen Kalk. Das Knochengewebe zwischen den Haversischen Räumen besteht fast ausschliesslich aus lamellärem Knochen mit Brecienbau. Nur unmittelbar am Periost sieht man Knochen von nicbt lamellärer Struktur. Auch dieser Knochen zeigt jedoch eine Andeutung von Mosaikzeichnung und enthält grosse Haversische Räume, die mit ähnlichen, tiefer

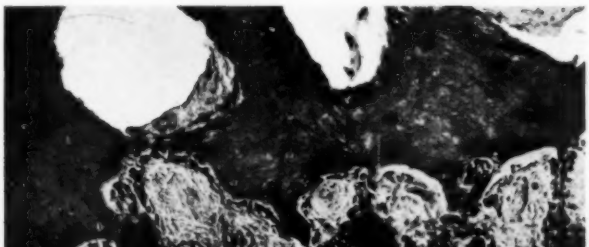


Fig. 7. Haem.- v. Gieson. Bild von der Grenze zwischen der grobporigen, aus lamellärem Knochen aufgebauten Kompakta und dem periphersten Teil des zentralen Herdes mit seinem neugebildeten, nicht lamellären Knochen. Die Knochenbalken des ersteren hängen mit denen des letzteren zusammen.

unten im Knochen gelegenen Hohlräumen in Verbindung stehen. Breite Haversische Räume und Volkmannsche Kanäle öffnen sich direkt in das periostale Bindegewebe. Die Knochensubstanz zwischen diesen Kanälen ist oft relativ unbedeutend, wodurch die obenerwähnte gezähnte Kontur entsteht. Das Periost ist verdickt, und man kann in ihm einerseits eosinophile Zellen, anderseits basophile, rundliche Zellen beobachten, die Ähnlichkeit mit den im zentralen Herd beobachteten grossen protoplasmareichen Zellen zeigen. Diese Zellen liegen mitunter in recht grossen Haufen; Knochensubstanz ist in ihrer nächsten Umgebung nicht zu sehen.

Die im Periost verlaufenden Gefässe sind erheblich verändert. Die kleineren Gefässe zeigen starke Anschwellung der Endothelzellen, und in den grösseren Gefässen sind Adventitia und Muscularis verdickt. In einzelnen von den grösseren Haversischen Räumen sind ähnliche, gröbere Gefässe vom selben Bau zu beobachten.

Blutkörperchen bildende Zellen und Fettmark fehlen vollständig.

4. Überblick über die wichtigsten Theorien bezüglich der physiologischen und pathologischen Auf- und Abbauprozesse im Knochensystem

Die oben beschriebene Knochenveränderung lenkt den Gedanken unwillkürlich auf das noch nicht gelöste Problem des feineren Baues der Knochensubstanz und die Auf- und Abbauprozesse in ihr.

Nach der alten Auffassung besteht der Knochen aus einer verkalkten, kollagenen Interzellularsubstanz; diese wird von den protoplasmareichen, basophilen Zellen gebildet, welche man die in Bildung begriffene Knochensubstanz bekleiden sieht. Diese Zellen, die Osteoblasten, werden während des Prozesses in das Knochengewebe eingeschlossen und dann zu Knochenkörperchen umgewandelt. Die Knochenresorption wiederum soll eine Funktion einer anderen Zellenart sein, nämlich der sogenannten Osteoklasten, mehrkerniger grosser Zellen, die in den bei Auflösung des Knochengewebes entstehenden Resorptionsgruben, den sogenannten Howshipschen Lakunen, liegen. Diese vielkernigen Riesenzellen mit dichtem Protoplasma, deren Oberfläche mit einem »Randsaum» versehen ist, entwickeln sich nach POMMER aus dem Gefässendothel. Die Knochenresorption erfolgt durch ihre kalk- und kollagenauflösende Tätigkeit — das Knochengewebe als solches verhält sich also passiv, während die Osteoklasten das aktive Element sind. In den Haversischen Räumen sieht man indes in den Resorptionsgruben nicht nur Osteoklasten, sondern auch einkernige Zellen, die dasselbe Aussehen haben wie Osteoblasten, und POMMER betont ausdrücklich, dass auch diese Zellen von Osteoklastennatur sind, sich aber unter atrophischen Verhältnissen entwickelten.

Die oben skizzierte Ansicht war bis vor einigen Jahren fast unbestritten und ist noch allgemein gangbar. Von manchen Seiten wurden jedoch berechtigte Proteste gegen sie erhoben.

LERICHE und POLICARD[1] sind der Ansicht, dass die Osteoblasten nicht Knochen bilden, sondern im Gegenteil verhindern, dass die Zwischensubstanz des Bindegewebes sich zu Knochen verwandelt. Wenn sich neuer Knochen bildet, so geht dies nach diesen Autoren so vor sich, dass in der Zwischensubstanz des Bindegewebes erst eine ödematöse Infiltration und eine Neubildung von Fibrillen stattfindet, dann folgt Infiltration einer präossösen Substanz, die schliesslich verkalkt. In dieser Metaplasie spielen die Zellen keine Rolle, sondern das ganze ist ein extra-zellulärer humeraler Vorgang. Die Zellen versuchen diesen Prozess zu verhindern, und eine Verknöcherung kann nur erfolgen, wo ihre Vitalität herabgesetzt ist. Die Knochenkörperchen sind solche Zellen mit herabgesetzter Vitalität. Gewinnen sie ihre Vitalität wieder, so ist die Folge eine Knochenresorption. Nach LERICHE und POLICARD ist knöcherne Metaplasie immer ein reversibler Prozess. Knochen bildet sich und verschwindet mit der grössten Leichtigkeit. Neubildung von Knochen geschieht jedoch niemals ohne Knochenresorption. Ebenso sicher ist Knochenresorption immer von einer Knochenneubildung begleitet. Wenn Knochen transplantiert wird, so beruht die Knochenneubildung auf der Resorption des

[1] Les problèmes de la Physiologie normale et pathologique de l'os. Paris 1926.

Transplantates. Es macht den Eindruck, als ob die Rarefizierung des Knochens einen lokalen Überfluss an Kalzium zur Folge hätte, der die knöcherne Metaplasie im Bindegewebe provoziert. Die Knochenresorption geht auf zweierlei Weise vor sich, einerseits durch Osteolyse, anderseits durch Osteoklasie. Beim ersteren Prozess erfolgt eine metaplastische Transformation der Grundsubstanz des Bindegewebes; der Knochen verschwindet ganz einfach durch einen humeralen Prozess, und das Bindegewebe kommt wieder zum Vorschein. Bei Osteoklasie geschieht die Auflösung durch Osteoklasten, die aus Osteoblasten entwickelte Phagozyten sind. Der erstere Prozess ist der wichtigere.

HÄGGQVIST[1] lancierte eine Theorie, die in gewissen Beziehungen Berührungspunkte mit der Ansicht von LERICHE und POLICARD hat, sich aber in anderen Beziehungen wieder wesentlich von dieser unterscheidet. WESTIN[2] gibt in folgenden Sätzen in gedrängter Form die Hauptpunkte dieser Theorie, wenn er schreibt, »HÄGGQVIST fasst den Knochen als Syncytium auf, eine zusammenhängende Protoplasmamasse, deren Ektoplasma Kalksalze und Kollagen enthält. Das Endoplasma umgibt die Kerne und bildet zusammen mit diesen sogen. Knochenzellen. Von der nächsten Umgebung des Kernes aus folgen wir einem Protoplasma von ausdifferentiiertem, endoplasmatischem Typus, das das canaliculare System des Knochengewebes ausfüllt. Knochenbildung und Knochenauflösung sind Stoffwechselprozesse von gleichwertigem Charakter im Protoplasma. Beides sind Zeichen einer protoplasmatischen Tätigkeit, wo wir sehr oft die sogen. Knochenzellen als die bei dem Stoffwechsel aktiv tätigen Zentra und die Knochencanaliculi als die Transportwege der Auf- und Abbauprodukte ansehen».

Die Knochenresorption beschreibt HÄGGQVIST folgendermassen: »Wenn ein Knochenbalken unter physiologischen Verhältnissen der Auflösung anheimzufallen beginnt, findet man, dass sich die Endoplasmagebiete vergrössern. Dabei nimmt die Mächtigkeit des Exoplasmas zwischen ihnen ab — das Endoplasma vergrössert sich auf Kosten des Exoplasmas — und die sogen. Knochenzellen beginnen, sich einander zu nähern. Gleichzeitig teilen sich ihre Kerne oft amitotisch, sodass zahlreiche Endoplasmagebiete 2—3 Kerne enthalten. Zuletzt verschwinden das Kollagen und die Kalksalze aus dem Exoplasma zwischen Gruppen der Endoplasmagebiete vollständig. Das Exoplasma des Knochens tritt an diesen Stellen »unmaskiert» in Form von grossen, vielkernigen Protoplasmaklumpen hervor. In diesen kann man oft die einzelnen Endoplasmagebiete, durch feine Septa von Exoplasma von einander getrennt, sehen; meistens

[1] Über Entwicklungs- und Auflösungsprozesse im Bindegewebe, Knorpel- und Knochengewebe. Acta Chir. Stockholm 1929.

[2] Beiträge zur Kenntnis des Hartsubstanzumbaues u. s. w. Svensk tandläkaretidskr. Stockholm 1926.

nimmt jedoch das Protoplasma ein gleichmässiges Aussehen an, und wir haben das Bild vielkerniger Riesenzellen vor uns, die in Vertiefungen der eigentlichen Knochensubstanz eingesenkt sind. Es ist klar, dass die Riesenzellen, deren Entstehung ich eben schilderte, nichts anderes sind als die seit langem bekannten »Osteoklasten».

Die Osteoklasten sind keine fremden Nager, die die Knochenauflösung verursachen. Sie sind vielmehr das Schlussstadium eines lokalen Knochenauflösungsprozesses, der das Protoplasma des Knochens unmaskiert hervortreten lässt. Ebenso wie die lebende Materie bei der Entwicklung des Knochens selbst Kollagen und Kalksalze in ihr Exoplasma ausfällt, besitzt sie die Fähigkeit, diese Stoffe aufzulösen und fortzutransportieren, wenn andere mechanische Verhältnisse eintreten.»

In Kenntnis der Untersuchungen von HÄGGQVIST und WESTIN nahm SIEGMUND[1] einige Versuche vor, um Einblick in die sogenannte osteoklastische Resorption zu erhalten. Es wurde feinzerteilte Knochensubstanz eines Tieres einem anderen subkutan einverleibt, wobei zu beobachten war, dass Fibroblasten in der Umgebung anschwollen, grösser wurden und ein basophiles Protoplasma erhielten. Durch mitotische und amitotische Kernteilung wurde ein Teil von diesen Zellen in Riesenzellen verwandelt. Gleichzeitig veränderten sich die Knochenkörperchen im Transplantat in einer Weise, die er mit folgenden Worten beschreibt. »Sie werden grösser, chromatinreicher, scheinen sich mit Protoplasma zu umgeben, während die Hartsubstanz in ihrer Nähe schwindet. Man hat durchaus den Eindruck, dass sich in ihrer Umgebung osteolytische Prozesse in den Hartsubstanzen abspielen, bis sie schliesslich immer mehr an den Rand des Knochenstückes geraten, hier in eine Resorptionsbucht zu liegen kommen und sich schliesslich als Osteoklasten den Zellen des Resorptionsbezirkes beigesellen. Wir scheinen hier die gleichen Bilder beobachtet zu haben, die HÄGGQVIST an der Katze und WESTIN beim Skorbut des Meerschweinchens als den einzigen Weg der Knochenauflösung gefunden haben wollen. Auf jeden Fall scheint uns der hier angedeutete Weg, eine Demaskierung der Knochengrundsubstanz durch Histiolyse und Einbeziehung ihrer sich in Osteoklasten umwandelnden Osteozyten in den retikulären Gewebsverband des umliegenden Gewebes hinsichtlich seiner Gültigkeit und seines Vorkommens weiteren Studiums wert zu sein».

Gleichzeitig beobachtete SIEGMUND in voller Übereinstimmung mit den Angaben von LERICHE und POLICARD eine Knochenbildung. Er schreibt darüber folgendes. »Die Weiterentwicklung des osteoklastischen Gewebes lässt sich deshalb schwer verfolgen, weil etwa vom 10. Tage an das histologische Bild durch nunmehr lebhaft einsetzende Knochenneu-

[1] Verhandlungen der Deutschen Pathologischen Ges. Jena 1926.

bildungsvorgänge kompliziert wird. Es mag hier die Feststellung interessieren, dass diese auch inmitten des osteoklastischen Gewebes auftreten. Doch ist es uns noch nach drei Wochen gelungen, die schönsten umschriebenen vaskularisierten riesenzellreichen Resorptionsherde — etwa einem »braunen Tumor en miniature» gleichend — nachzuweisen».

Die bei der Knochenresorption beobachteten Riesenzellen will er indes nicht lediglich als »demaskierte» Knochenkörperchen erklären, sondern er meint, wie aus folgendem Zitat hervorgeht, dass sie auch durch Teilung von Bindegewebszellen und Gefässwandzellen entstehen: »Was uns veranlasst hat, diese nicht einmal abgeschlossenen und schliesslich selbstverständlichen Untersuchungsresultate hier zu besprechen, waren im wesentlichen die Feststellungen, die hinsichtlich der Entstehung und Bedeutung der Riesenzellen gemacht werden konnten. Wir haben uns überzeugt, dass ihre Entwicklung allenthalben aus den Zellen des ortständigen Bindegewebes und der Gefässwand auf amitotischem Wege, nicht durch Verschmelzung erfolgt, nicht nur in nächster Nähe des knöchernen Abbauherdes, sondern auch in seinen peripheren Ausläufern. Manches spricht dafür, dass auch Osteozyten nach Auflösung der Grundsubstanz sich zu diesen Zellen heranbilden können. Sie entstehen jedenfalls erst im Verlaufe einer resorptiven Beanspruchung des aktiven mesenchymatischen Gewebes auf Grund einer Verarbeitung spezifischer Stoffe, die dem Knochenabbauherd entstammen. Dabei kann ihre Ausbildung als ein Funktionswachstum bezeichnet werden, das bei einem Überangebot von Nahrung entsprechend allgemeinen zellphysiologischen Vorstellungen ohne Unterbrechung der Zelltätigkeit auf amitotischem Wege erfolgt.

In diesem Sinne ist es berechtigt, sie den Riesenzellbildungen bei den sogenannten Wucheratrophien (des Fettgewebes, der Nervenfasern und der Muskulatur) an die Seite zu stellen, auch dann, wenn man die Möglichkeit der Umbildung von Osteozyten in Osteoklasten zugibt. Jedenfalls kennt die Zoologie und Anatomie eine grosse Reihe von Beispielen, wo beim Zerfall spezifischer Strukturen die Kerne der zugeordneten Zellen zu amitotischer Vermehrung angeregt werden (Benninghof). Auch die Osteoklasten bewältigen den Abbau eines spezifischen Substrates und sind den vielkernigen Gebilden, die bei der Auflösung von Muskeln, Nerven und Bindegewebsfasern auftreten, wesensgleich. Hier liegen auch ihre Beziehungen zu den Fremdkörperriesenzellen, die nach unseren Erfahrungen nur um dem Abbau zugängliches Material auftreten».

Wie ersichtlich, sind die obenerwähnten Verfasser in einem Punkte einig, nämlich darüber, dass die Osteoklasten sich aus den Osteoblasten bilden können. Leriche und Policard sowie Siegmund sind der Ansicht, dass sie eine phagozytäre Fähigkeit haben, messen aber der sogenannten lakunären Resorption sehr geringe Bedeutung bei. Während Westin die Frage des Vorkommens einer lakunären Resorption offen zu lassen

scheint, geht HÄGGQVIST in seiner Theorie weiter und bestreitet das Vorkommen einer lakunären Resorption vollkommen. Osteoblasten, Osteozyten und Osteoklasten sind also ganz dasselbe. Was ihre Funktion betrifft, so ist HÄGGQVIST der Ansicht, dass sie Knochen sowohl aufbauen als abbauen, während LERICHE und POLICARD ihnen nur die Fähigkeit des Abbaus zuerkennen will. Bezüglich der amorphen Grundsubstanz unterscheidet sich die Auffassung der französischen Verfasser von der HÄGGQVISTS darin, dass sie an der alten Lehre von den Zellen und einer Interzellularsubstanz festhalten, während HÄGGQVIST HANSENS Theorie über das Bindegewebe als ein einziges Synzytium dahin verallgemeinern will, dass sie auch für das Knochensystem gilt.

SIEGMUND hat sich mit den Riesenzellen befasst, die bei pathologischer Knochenresorption vorkommen, so z. B. bei den vielen verschiedenen Formen von Ostitis fibrosa, Riesenzellentumoren, Epuliden usw., und fand, dass sie anderer Abstammung seien als die Osteoklasten.

Erörterung der Natur und Pathogenese des beschriebenen Krankheitsprozesses

Von vornherein ist ja klar, dass es sich hier weder um einen entzündlichen Prozess, noch um eine Tumorbildung handelt. Vielleicht würde man denken können, dass der zentrale homogene Herd einem Chondrom entspricht. Dieser Gedanke muss indes aufgegeben werden, da hier proliferierende Geschwulstzellen vollständig fehlen. Auch lässt sich das Gebilde nicht mit den intramedullären Absprengungen vom Epiphysenknorpel vergleichen, die unter dem Namen Enchondrosen, Enchondrome oder Chondrome beschrieben werden, und die auf der Knochenoberfläche ihr Gegenstück in den sogenannten kartilaginären Exostosen haben. Solche Gebilde können allerdings, wo man sie intramedullär vorfindet, eine rundliche Form haben und auf der Oberfläche Knochen bilden, diese Knochenbildung hat aber ein ganz anderes Aussehen und ist lokaler Natur. Im vorliegenden Falle ist dagegen der beschriebene Herd das Zentrum des Umbauprozesses, der ein grosses Gebiet des ganzen Knochens betrifft.

Trotzdem das hier beschriebene Gebilde also keine Ähnlichkeit mit den Enchondrosen oder Enchondromen hat, ist es doch das Nächstliegende, zu denken, dass wir auch hier einen Zustand vor uns haben, der auf einer Störung in der normalen Knochenentwicklung während des Embryonallebens beruht. Das oben beschriebene Gebilde enthält keine Knorpelzellen, ist also kein Knorpel, ja, es ist zweifelhaft, ob es überhaupt Zellen enthält ausser denjenigen, welche die hineinwachsenden Gefässe begleiten. Die homogene Masse gleicht indes am ehesten der Interzellularsub-

stanz im Knorpel, und es ist deshalb denkbar, dass es sich hier um einen zurückgebliebenen Rest von embryonalem Knorpel handelt, der solche regressive Veränderungen durchgemacht hat, dass seine Zellen verschwunden sind. Aus irgend einem Grunde gab dieser Herd dann Veranlassung zu einem Knochenneubildungsprozess. Die Ursache hierfür ist dunkel. Vielleicht handelt es sich um einen exogenen Faktor in Form eines Traumas. Der Beruf der Patienten lässt hieran denken. Im einen Falle, wo das Leiden den 2. Metatarsalknochen traf, handelte es sich nämlich um eine Kellnerin mit einem ausgesprochenen Plattfuss, im anderen Falle, wo der Prozess in der Grundphalange des Mittelfingers lokalisiert war, um einen Chauffeur.

Im Hinblick auf den wahrscheinlich embryonalen Charakter der Krankheit soll hervorgehoben werden, dass die beiden Patienten junge Individuen, 16 resp. 18 Jahre alt waren. Auch die Lokalisation des Leidens ist in den beiden Fällen von diesem Gesichtspunkte bemerkenswert. Im Metatarsalknochen lag das Zentrum des Prozesses, wie vorher erwähnt wurde, proximal, in der Phalange dagegen distal. So müsste es sich auch verhalten, wenn das Leiden seinen Grund in einer frühen, embryonalen Störung hat, weil der Epiphysenknorpel, von dem das Längenwachstum des Knochens ausgeht, im zweiten Metatarsalknochen distal liegt, und in den Phalangen, sowohl bei der Hand als auch beim Fuss proximal (siehe Fig. 8). Der Herd muss natürlich in dem nicht wachsenden Ende des Knochens liegen. Ferner soll in diesem Zusammenhang darauf hingewiesen werden, dass die Entwicklung der Metatarsalknochen des Fusses und die der Grundphalangen der Finger gleichzeitig verläuft. Die Verknöcherung dieser Knochen tritt im 3. Embryonalmonat ein, während die der Grundphalangen der Zehen etwas später, im 4. Monate, folgt.

Wenn man aus den bei diesem Leiden beobachteten Bildern Schlüsse über den Verlauf des Verknöcherungsprozesses im vorliegenden Falle und somit über den Verknöcherungsprozess im allgemeinen ziehen will, so steht man vor den Schwierigkeiten, welchen man stets begegnet, wenn man aus histologischen Präparaten konstruieren will, was wirklich geschehen ist. Dies ist die Erklärung dafür, dass die Theorien über den Ab- und Aufbauprozess des Knochens so divergierend sind, wie es der Bericht im vorigen Kapitel wiedergibt. Es geschieht deshalb mit allem Vorbehalt, wenn ich die nachstehenden Versuche einer Deutung vorlege.

Man bekommt unstreitig den Eindruck, dass der Prozess mit einer Vaskularisierung der amorphen Masse eingeleitet wurde. Die Gefässe werden von den grossen basophilen Zellen begleitet, deren Funktion darin zu bestehen scheint, die amorphe Masse durch Resorption zu Balken umzumodellieren, die sich sodann in Knochen verwandeln können. Ihrer Funktion nach würden diese Zellen also Osteoklasten sein. Was ihren Ursprung betrifft, so hat es zweifellos den Anschein, dass sie vom Endothel

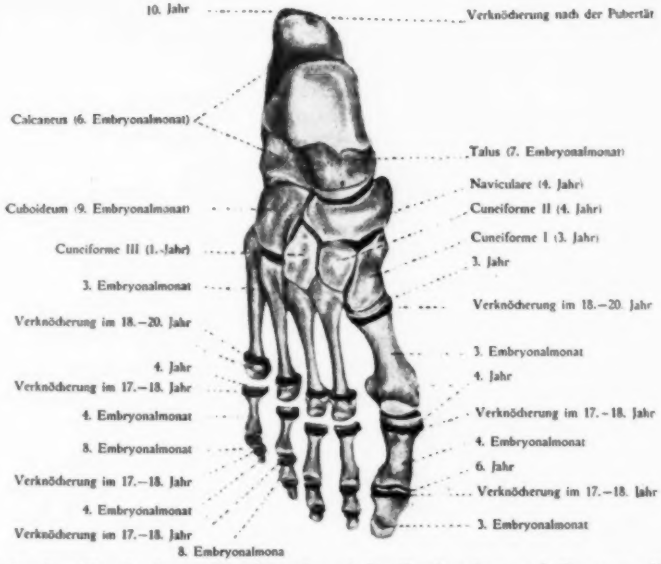


Fig. 8. Sekundäre Knochenkerne (Epiphysenkerne) der Fussknochen nach BROMAN »Normale und abnorme Entwicklung des Menschen».

der Gefässe herrührten, und es kann dann von Interesse sein, dass POMMER sowie SIEGMUND, wie erwähnt, gezeigt zu haben glauben, dass Osteoklasten aus Gefässendothelien entstehen können. Nachdem der Prozess weiter vorgeschritten ist, trifft man längs den Balken nicht nur die eben erwähnten Zellen an, sondern auch Osteoklasten vom klassischen, mehrkernigen Typus. In der äussersten Peripherie des Herdes, an der Grenze zum lamellären Knochen, gehen die basophilen Zellen in knochenbildende über und werden in Form von Knochenkörperchen in die Knochenbalken eingeschlossen. Diese basophilen Zellen entsprechen in ihrem Aussehen in jeder Beziehung Osteoblasten. Aber wie können dann die Osteoblasten in zentraleren Teilen des Herdes als Osteoklasten funktionieren? Hierauf kann man antworten, dass die Funktion des Osteoblasten nach der seit altersher gangbaren Ansicht allerdings ausschliesslich im Knochenaufbau besteht, dass die modernen Theorien dies aber bestreiten. Am weitesten gehen diesbezüglich, wie wir sahen, LERICHE und POLICARD, die diese Funktion der Osteoblasten vollständig bestreiten. Stellt man die Annahmen LERICHES und POLICARDS über die Funktion der Osteoblasten mit der Auffassung HÄGGQVISTS zusammen, nach der die Osteoblasten und Osteoklasten Zellen derselben Art sind, und erinnert sich ferner an die Behauptung von POMMER und von SIEGMUND,

dass sich die Osteoklasten aus Gefässendothelien bilden und ausserdem nicht immer mehrkernig sind, so scheint mir nicht eben viel gegen die oben skizzierte Erklärung des hier vorliegenden Prozesses einzuwenden zu sein. Von Interesse ist in diesem Zusammenhang, dass WESTIN, wie er mir mündlich mitteilte, bei skorbutischen Prozessen in den Zähnen einen Knochenresorptions- und Knochenneubildungsprozess gefunden hat, der prinzipiell in derselben Weise verläuft, d. h. mit Osteoklasten, die aus Gefässendothelien entstanden, und dann in der Peripherie des Herdes in knochenbildende Osteoblasten übergehen. Diese Befunde befinden sich gegenwärtig in Publikation.

Was wieder den Umbau der Kompakta betrifft, so geht dieser in derselben Weise vor sich, wie es normalerweise beim Umbau des Skeletts im Embryonalleben und in den ersten postembryonalen Lebensjahren geschieht.

Man kann sich schliesslich fragen, wie sich diese Fälle entwickelt hätten, wenn sie nicht operiert worden wären. Die Frage ist natürlich schwer zu beantworten, es erscheint aber wahrscheinlich, dass der Prozess zum Stillstand gekommen wäre, sobald der ganze zentrale Herd in Knochen verwandelt gewesen wäre. Sicherlich hätte dies eine noch wesentlichere Verdickung des Knochens im ganzen mitsichgebracht, ein Zustand, der natürlich fortgesetzt Beschwerden verursacht hätte.

ZUSAMMENFASSUNG

Verf. beschreibt zwei Fälle einer Krankheit, die seiner Ansicht nach bisher nicht beobachtet wurde. Bei beiden Fällen war in einem der langen Knochen des Fusses resp. der Hand langsam eine Auftreibung aufgetreten, die Schwellung und Schmerzen verursachte. Die Röntgenaufnahme zeigte Verdickung des Knochens, und im einen Falle sah man subkapitulär einen rundlichen Verdünnungsherd. Wegen Verdachtes auf osteoblastisches Sarkom wurden die Patienten operiert, wobei man im einen Falle Resektion, im anderen Exartikulation ausführte. Die anatomische Untersuchung zeigte, dass es sich hier weder um eine Tumorbildung noch um einen entzündlichen Prozess handelte, sondern um einen Wachstumsprozess anderer Art mit dem oben erwähnten Herd als Zentrum des Prozesses. Dieser Herd bestand aus einer zentralen amorphen kollagenen Masse, die von einer blutgefässreichen Zone umgeben war, aus der Gefässe und Osteoblasten in die erstere eindringen. Verf. versucht wahrscheinlich zu machen, dass die Störung embryonaler Natur ist und weist dabei unter anderm auf das jugendliche Alter der Patienten hin, 16 resp. 18 Jahre.

SUMMARY

The author describes two cases of a disease supposed to be hitherto unknown. In both cases the patients, aged 16 resp. 18 years, showed enlargement of one of the long bones of the hand or foot, which had caused swelling and considerable

pain. Roentgen examination showed an increase of the volume of the bone, and in one of the cases there was a thinning of the shadow in the most thickened end of the diaphysis. The patients were operated on, since the cases were diagnosed as osteogenic sarcoma. In one case a resection was made; in the other an exarticulation. The histopathological examination revealed a bony newgrowth, which was neither a tumor nor an inflammatory process. This newgrowth evidently originated from a focus corresponding to the above mentioned thinning, which was built up of a central amorphous, collagen substance surrounded by a highly vascularised zone of spongy bone. From this zone vessels and osteoblastes penetrated into the central mass. According to the author, the process seems to be of embryonic origin.

RÉSUMÉ

L'auteur décrit deux cas d'une maladie, qu'il ne croit pas avoir été antérieurement observée. Dans les deux cas, il s'agit d'une hypertrophie osseuse d'un des os longs du pied, respectivement de la main, se produisant lentement, et déterminant une tuméfaction et des troubles fonctionnels. L'image radiographique montrait un élargissement et une condensation de l'os et au niveau de la tête, une région translucide. Soupçonnant un sarcome ostéoblastique, on a fait dans l'un des cas une résection, dans l'autre une désarticulation. L'examen anatomique a montré qu'il ne s'agit pas d'une tumeur, ni d'une affection inflammatoire, mais d'une néoformation osseuse d'une autre espèce, la région translucide susdite formant le centre de l'altération pathologique. Le foyer en question se composait d'une substance centrale, amorphe et collagène, entourée d'une zone richement vascularisée. De cette zone hyperémique, des vaisseaux et des ostéoblastes pénètrent dans la substance centrale. L'auteur suppose que l'affection est d'origine embryonnaire et signale à ce propos le jeune âge des malades, 16 ans et 18 ans.

FROM RADIUMHEMMET, STOCKHOLM. (CHIEF: DOCTOR ELIS BERVEN)

CASTRATION BY ROENTGEN RAYS AS AN AUXILIARY TREATMENT IN THE RADIOTHERAPY OF CANCER MAMMAE AT RADIUMHEMMET, STOCKHOLM

by

Hugo Ahlbom

At the Surgical Congress in Germany in 1889 SCHINZINGER suggested bilateral oophorectomy as an auxiliary method of treatment in cancer of the breast. In so doing this author introduced the novel idea in the treatment of cancer mammae that the disease might be accessible for indirect influence by way of an endocrinic organ. Independently of SCHINZINGER BEATSON in England advanced the same suggestion in 1896. In addition to sterilization this author prescribed thyroid medication. In so doing he tried to apply the then modern researches by BROWN-SEQUARD and others concerning glands with internal secretion. In the opinion of BEATSON the thyroid preparation would aid the effect of castration in the treatment of cancer mammae because of the thyroid and the ovaries having a contrary hormonal effect on the mammary gland.

The way SCHINZINGER argued was as follows: Cancer of the breast has a more rapid and more malignant course in younger women than in those of more advanced age. Did there exist a means by which it would be possible to hasten the old age in women, one would thereby be able to improve the prognosis in cancer mammae. Castration is to some extent such a means as it produces climacteric changes before time is due.

BEATSON argued differently in putting forth his suggestion. He rather thought that the occurrence of cancer in the breast was wholely or partly dependent upon an abnormal function of the ovaries. Removal of these organs would therefore, at least in some cases, simply eliminate the cause of the disease. As early as in 1896 BEATSON was able to show encouraging results of the new method of treatment. During the next few years he observed and described considerable local improvement in some of the cases operated on, in the form of shrinkage of the primary tumour, reduction or disappearance of skin metastases besides retrogres-

sion of glandular metastases. In addition to this he was often able to notice improvement of the general condition and amelioration of symptoms. About 1902 he had gained so much experience of the method as to be able to state more precisely its indications. He maintained that oophorectomy was only justified when dealing with menstruating women over 40 years of age but declared expressively that no beneficial effect was to be expected in cases with metastases in viscera or bones.

BEATSON has had several followers particularly among English surgeons. Numerous results have been submitted in a statistical form by STANLEY BOYD, THOMSON and LETT. BOYD collected 54 cases of which 19 showed improvement, THOMSON 80 cases with 29 improved. LETT collected 99 cases and found improvement in about 23 per cent. If he excluded cases over 50 years of age this figure rose to 41 %. MICHELS who himself published a few cases in which he thought he had found beneficial effect of castration treatment points out that the figures submitted by the above mentioned authors cannot be given too great a prominence because of the difficulty of impartially estimating an improvement in the condition.

Cases of favourable temporary improvement have also been published by HERMAN and REYNÈS (the latter the first time in 1904 and last time in 1921) and by SMITH, ANNANDALE and DONALD; these three authors believe they have through castration influenced a few inoperable cases in a favourable manner, rendering them operable.

I have found no later publication than that of REYNÈS in 1921 on the subject of operative castration in cancer mammae. This finds its explanation in the fact that lately radiotherapy has come to the fore as a new method of treatment at the side of surgical measures for the condition in question. FOVEAU de COURMELLES was the first to try roentgen-ray irradiation of the ovaries in cases of cancer mammae as a substitute for castration by operation which he knew from the works of BEATSON, REYNÈS and others. He began this new method in 1904 and in 1909 he published his first report on the cases treated up till then. After a number of communications of smaller compass during the next few years he submitted in 1922 a summary account of his experience with the method in question. By that time he had in 8 cases, which had all obtained combined roentgen treatment over the breast and the ovaries, found a considerable improvement. He says he has found that the mammary tumours have receded quicker in the case of the ovaries also being irradiated than if the breast only was treated, and that the result of the roentgen treatment has been better and more certain than after operative sterilization.

In Germany HANS MEYER was the first to suggest ovarian irradiation in cases of cancer of the breast. WINTZ introduced roentgen castration in his clinic in 1918 and has since 1920 been using it regularly as part of the

treatment of cancer mammae. He has in 103 cases supplemented the direct treatment of the tumour with irradiation of the ovaries and he is under the lively impression that this additional measure is of great importance. WINTZ has had the same experience as BEATSON that the beneficial effect of sterilization is left out in the case of distant metastases being already present.

There are some still further publications which go to show that sterilization by roentgen rays has been used also in other European and American clinics (LAPEYERE, FRANGENHEIM, KAPLAN). The last mentioned author describes the use of the method solely in order to prevent pregnancy in patients suffering from cancer mammae.

Among the authors who have lately been discussing the theory of castration treatment REYNÈS is the only one who has adopted BEATSON's view of the etiological importance of the ovarian hormones for cancer mammae. On the other hand do we find that SCHINZINGER's view on the matter, though modified, is the view generally held at the present day; a brief description of this, mainly in accordance with WINTZ's detailed account of it, will be set out below.

1. Castration, obtained through operation or radiological treatment, results, like the natural process of climacteric, in atrophy of the mammary parenchyma which is partly replaced by fatty tissue. This process of involution may conceivably bring about similar retrogressive changes also in the cancer emanating from the parenchyma and perhaps also in its metastases. In such way, then, could cases be explained where tumours have disappeared without any other treatment than castration.

2. Through hormone stimulation the ovaries give rise to the swelling of the mammae that in most women can be observed premenstrually. The marked physiological changes observed in the breast during pregnancy and lactation are elicited in a similar manner. By sterilization these hormone stimulations are eliminated. It is a fact that irritations of different kinds may hasten the growth of a malignant tumour and counteract the beneficial effect of therapeutic measures. If assuming that such stimula from ovarian hormones as just mentioned can have such an unfavourable effect upon a mammary cancer then castration ought of course to be able to eliminate this risk.

3. Even should not the hormones have such a direct influence on the malignant tumour, it may nevertheless be assumed that the associated hyperaemia and activity of the breasts during pregnancy and lactation may have caused such an irritation.

WINTZ attaches particularly great importance to this last view of his. He writes as follows: »Natürlich muss man sich die Frage vorlegen, ob denn die Ausschaltung der Ovarien bei einer Frau mit Mammacarcinom nur zweckmässig oder ob sie auch notwendig ist. Ich möchte die Not-

wendigkeit bejahen, selbst dann, wenn der angenommene hormonale Reiz unschädlich sein sollte. Denn in der Möglichkeit einer Schwängerung nach der Röntgenbestrahlung des Mammacarcinoms, ebenso wie nach der Operation, sehe ich eine sehr grosse Gefahr». In support of his contention he refers to 7 cases of cancer mammae in which he observed rapid progress and death during the first few months of a commencing pregnancy. WINTZ also maintains that cessation of menstruation has a beneficial effect upon the general state of health and the power of resistance.

Experimental cancer research has lent a certain amount of support in justification of castration treatment. Large experimental series carried out by MAUD SLYE, LOEB, LATHROP, CORI and MURRAY have shown that by applying the laws of heredity one has been able to breed races of mice in which cancer of the breast is of very frequent occurrence. If a certain number of females of such a stock are sterilized in good time before it is usual for the cancer generally to arise, it is regularly found that these animals develop mammary cancer to a very much less extent than the non-sterilized animals of the same race. As to what extent these experimental findings can be applied to the conditions in man is a question not easily answered.

There is, however, no lack of data in the literature devoted to criticism of the theoretical basis of the castration treatment. Already at an early stage MORISON argued with BEATSON in the following manner, an argument that has also been advanced from other quarters. The fact that mammary cancer so often arises in elderly women long after the climacteric periods does not fit in well with the view that castration is a means whereby the development of this disease can be counteracted. Both MORISON and SITZENFREY have further presumably found that mammary cancer remarkably often arises in women who have earlier undergone bilateral oophorectomy on account of tumour or some other condition of the ovaries. The view, however, that this operation would result in an augmented disposition to cancer of the breast is refuted by WINTZ who bases his arguments on an after-examination of his gynecological cases.

SEMB has recently shown in his work on fibro-adenomatosis cystica mammae, not only that this condition is mainly met with in nulliparae and women with few children, but also that mammary cancer in no less than 80 % seems to be secondary to a fibro-adenomatosis cystica. If these observations are correct, one would conclude that sterilization, by preventing pregnancy, would rather contribute to the occurrence of fibro-adenomatosis cystica and thereby cancer than having a preventative effect upon the development of cancer of the breast.

Indications for Roentgen Irradiation of the Ovaries in Cancer Mammae at Radiumhemmet

Irradiation of the ovaries in patients with cancer mammae has been tried at Radiumhemmet since 1922. One was led to adopt this treatment in the first place by FOVEAU de COURMELLES's communication. As the question of the value of this treatment cannot be said to have been definitely solved, we have regarded the group of cases thus treated in the course of six consecutive years as an experimental series. The indications for treatment have therefore not followed any definite outlines, cases of rather different character having been treated with the view of gaining experience of the method.

Ovarian irradiation, however, has only, except in a few cases, been adopted as an auxiliary method of treatment. We have never used it for two large groups of patients with cancer mammae, namely in the first place operable cases for which — may be after preoperative irradiation — operation has been planned and, secondly, operated cases clinically free of symptoms and admitted for postoperative treatment. One has not considered oneself justified in trying a treatment of so demanding a character in these groups where the prognosis in any case is relatively favourable. In the remaining groups, on the other hand, ovarian irradiation has been given to about one-third of the patients, i. e. inoperable cases and cases with recurrences or metastases after a previous operation. The other two-thirds have only been given radiological treatment applied directly to the tumour.

In selecting the cases special regard has been had to the following factors:

1. Age. Irradiation with the view of castration has not only been given to menstruating patients but also, in accordance with the aim of testing the method, to women having already entered the climacteric period. The mode of reasoning on which these experiments have been based has been that a certain internal secretory function remains in the ovaries at least for some little time after the onset of menopause. When, therefore, we speak of castration here, it should not always be understood as the production of menopause but the expression should be used in the wider sense of interruption of the internal secretory activity of the ovaries.

2. The clinical type and localisation. The treatment has been given in all the usual clinical types of cases in the presence of tumours, recurrences and metastases of all ordinary localisations with the exception of metastases in lung and liver. Thus we have also treated cases with skeletal metastases. This because the first attempts at ovarian irradiation in

cases of metastases in bone were to some extent encouraging wherefore this line was continued with with the view of accumulating experience.

3. Stage of disease. As often happens in experimental series of cancer therapy many prognostically unfavourable and far advanced cases have been included. Particularly during the first few years has ovarian irradiation been given to such cases in which on account of an impaired general condition or a generalised cancer a routine radiological treatment would scarcely in the ordinary course of events have been deemed indicated; such irradiation has generally been combined with some other form of radium- or roentgen treatment. In spite of the bad outlook in such cases one has hoped for a possible amelioration of symptoms, at the same time as one has had the opportunity of studying the effect of the castration treatment.

In accordance with BEATSON's suggestion thyroid gland has been given to all patients who have been irradiated with the view of castration. For various reasons, especially such of financial nature, the patients have often failed to carry through this medication. This has also been difficult to check as the cases have generally been out-patients. It is scarcely possible, therefore, to arrive at any conclusions as regards the value of the thyroid treatment among the patients at Radiumhemmet.

The Clinical Material

In accordance with the indications briefly accounted for above 163 women in all with cancer mammae were given ovarian roentgen irradiation during the period 1922—1928 inclusive. The average age of these woman is 51 years. The number of those over 45 years of age is 90 (56 %).

The clinical material is mainly made up of operated patients (132 cases) who subsequently developed recurrences or metastases. The remaining 31 cases have had primarily inoperable tumours which have exclusively been treated radiologically.

The 132 cases of recurrences or metastases after operation have had local recurrences, metastases in the skin, lymphatic glands, the other breast or in skeletal parts. Usually there have been both local recurrences and metastases. 67 patients were admitted in that stage without having had any earlier radiological treatment. There are 65 patients among those who have obtained pre- or postoperative treatment or postoperative treatment only at Radiumhemmet and who subsequently developed recurrences or metastases. The recurrences or metastases present at the commencement of the ovarian irradiation were found in the latter category of patients either during the postoperative treatment or at the routine control examinations after the termination of such treat-

ment. Among this group of cases with recurrences and metastases after operation 98 or about 75 % showed signs of spread of the cancer beyond the regional lymph-glands at the time when the ovarian irradiation was given.

The 31 cases of inoperable primary tumour, exclusively treated radiologically, have all presented the picture of a generalised cancer.

Technique of Treatment

With regard to the local treatment by radium or roentgen of cancer mammae at Radiumhemmet the reader is referred to works by BERVEN and WESTERMARK.

In the ovarian irradiation the roentgen dosage has been so graded after the anatomical conditions that the active dose for each ovary has been at least 40 % of SED (40—50 % according to deep dose measurements carried out by R. THORÆUS). For this purpose a superficial dose of $^2/_3$—1 SED at a focal distance of 30 or 40 cm. and with a filter of 0.5 mm. Cu + 1 mm. Al has been given over two anterior fields, measuring 12 × 12 cm. and a dose of $^2/_3$—$^3/_4$ SED over a common back field measuring 20 × 20 cm. The whole treatment has generally been given in the course of three days. The current used has been 6 milliamp. and the effective tension 160 kilowolt. By this technique the menstruation has definitely ceased. The so-called symptoms of defunctionalisation have rarely been very troublesome. Nausea and vomiting have fairly often occurred in connection with the irradiation. On the onset of such symptoms or when suspected on account of an impaired general condition the treatment has as a rule been spread over several days so that for example only $^1/_3$ SED or $^1/_4$ SED has been given on each occasion.

Results

From what has been said about indications and the character of the cases at Radiumhemmet it will be clear straight away that ovarian irradiation has as a rule been applied to such cases in which there has scarcely been any hope of obtaining any freedom of symptoms but only temporary improvement. When now trying to form an unbiassed opinion of the value of the method under such conditions one first comes up against the difficulty of correctly estimating the effect. But even if disregarding the subjectivity which I suppose must always attach to the estimation of such factors as improvement of the general condition, amelioration of pains in cases with skeletal metastases only and duration of the period of

improvement, we have further to consider the fact that at Radiumhemmet radiological treatment has as a rule also been applied directly to the tumour itself in addition to the ovarian irradiation. It is impossible, therefore, to decide from case to case which of the two treatments has been mainly responsible for a certain result. In order to be able to form a proper estimation, therefore, it is most important to have a group of cases at one's disposal for comparison to which no ovarian irradiation has been given. In the opinion of WINTZ it is on the whole impossible to express in figures the value of the castration treatment. In so far that this applies to WINTZ's own cases such a view must in the first place be due to the fact that, contrary to what has been done at Radiumhemmet, he has carried out the treatment in all his cases and consequently lacks any simultaneous material for comparison. During the period 1922—1928, 308 cases of recurrences and metastases after operation and inoperable cases have been treated radiologically without having obtained any ovarian irradiation. This group, however, cannot be used for comparison straight away, for regard must be had to the fact that certain differences exist between the two groups. In the first place, then, the castrated cases are somewhat younger than the others. The average age in the former group is 51 while in the latter group it is 54 years. Secondly, there is a relatively greater number of advanced cases in the group treated by castration.

In what follows I have tried to form an opinion as to how these differences affect the comparison between the material proper and the control cases and as much as possible to free it from these discrepancies.

The effect that may be expected in cancer mammae of a therapy such as ovarian irradiation is of two kinds: firstly, prolongation of life, secondly, improvement of the local and general condition for a certain length of time.

Regarding the duration of life I have confined the comparison to one between the deceased patients. With regard to those still alive, which are very much fewer in number than those dead, a classification into different groups according to their duration of life up to the present is valueless on account of a far too small number of cases in the respective groups. In estimating the duration of life I have reckoned this either from the time of operation, if any, or, in the case of inoperable patients, from the commencement of the radiological treatment. There are of course two other possibilities, namely to reckon it from the onset of the first symptoms or from the commencement of the ovarian irradiation. In the former case, however, there is the difficulty of the data of the first symptoms in many cases being inexact, in the latter a corresponding starting point for estimating the duration of life in the control cases will be lacking.

As improved have been entered those cases for which the reports show an obvious retrogression of the primary tumours, recurrences or

metastases or — in the presence of skeletal recurrences only — where there has been a reduction or cessation of pains and a definite improvement of the general state of health for at least 3 months. Although it would no doubt have been of great interest to classify the cases according to degree of improvement, e. g. in respect of frequency of regained working capacity, it seems to me it would have left far too much scope for subjectivity in the estimation.

When we go to critically examine the improvement it will not be possible to use all the 308 cases because those cases treated pre- and post-operatively were admitted for radiological treatment before any clinical signs of recurrence or metastasis had been found. If these groups are deducted from the control cases, there remain 141 cases of primarily inoperable tumours or recurrences and metastases after operation, in which it can then be assumed that the improvement was occasioned by the radiological treatment.

Among the 163 castrated cases 16 have received no simultaneous radiological treatment directed against the primary tumour. The clinical course in these cases ought to be particularly suited for clarifying the value of the treatment. It should be pointed out, however, that all these cases were particularly far advanced with generalised cancer. The reason for omitting direct roentgen irradiation in these cases was their apparent hopelessness on account of far too widespread tumours or metastases or that the treatment would have been too strenuous in consideration of the poor general condition.

The result in this group will be found to be almost negative.

Table 1.

Comparison of average duration of life and rate of improvement between cases treated by castration only and those also irradiated directly for the tumour. Duration of life reckoned from operation or from commencement of radiological treatment in respect of inoperable cases.

	Number of cases	Deaths	Duration of life (average)	Number of improved
Castration only	16	16 (100 %)	13.5 ± 2.2 mths (dispersion = ± 9 mths)	1 (6.3 ± 6.1 %)
Castration + direct irradiation of tumor	147	105 (71 %)	24.5 ± 2.3 mths (dispersion = ± 24 mths)	61 (41 ± 4.8 %)
			Difference: − 11 ± 3.2 mths.	Difference: − 34.7 ± 7.8 %.

All the 16 cases are dead and their average duration of life reckoned from the operation or the commencement of the radiological treatment

is considerably below the corresponding figure for all the castrated cases. 15 of the cases have gone rapidly and continuously worse after the ovarian irradiation.

One case is noted as improved after ovarian irradiation alone. A brief account of this case will be given below.

Case 1. H. Å. woman, aged 68, admitted April 1923. Had noticed a tumour of the breast for the last 10 months. She was found to have a discshaped, ulcerated tumour, measuring 6 × 6 cm., in one of the breasts besides two fixed glandular metastases, the size of walnuts, one in the axilla and one in the supraclavicular fossa. Patient was given the usual castration dose with roentgen rays. Direct irradiation of the tumour was not considered indicated in regard to her impaired general condition. After a couple of months the tumour had shrunk a little, now measuring 5 × 6 cm. The glandular metastases were unaltered. She felt stronger. The condition again showed progression after a couple of months. Patient died in February 1924.

This case cannot of course be said to constitute any convincing proof of the value of the treatment. The objective improvement was exceedingly slight, not to say uncertain, and the subjective improvement may of course have ensued by suggestion.

The result of castration in the group of cases solely treated by that method, all of them being in a far advanced stage of the disease with the general condition impaired, is thus of negative nature. When in what follows we pass on to examine those cases where both castration treatment and direct irradiation of the tumour have been given, we must for reasons earlier stated compare the result with the cases not treated by sterilization.

The result of such a comparison referring to all cases has been set out in the following two tables.

Table 2.

Comparison of average duration of life between cases treated by castration and those not so treated, all deaths included. Duration of life reckoned from the operation or from the commencement of the radiological treatment in respect of the inoperable cases.

	Number of cases	Deaths	Duration of life (average)
Castration only or castration + direct irradiation of tumour	163	121 (75 %)	23 ± 2.1 mths (dispersion = ± 23.5 mths)
Direct irradiation of tumour only . .	308	226 (73 %)	25 ± 1.8 mths (dispersion = ± 27.2 mths)

Difference: − 2 ± 2.8 mths

Table 3.

Comparison of rate and duration of improvement between castrated and non-castrated cases. The improvement reckoned from the ovarian irradiation or from the commencement of radiological treatment in respect of the control cases.

	Number of cases	Improved	Duration of improvement (average)
Castration only or castration + direct irradiation of tumour .	163	63 (38.7 ± 3.8 %)	17.5 ± 1.8 mths (dispersion = ± 14.1 mths)
Direct irradiation of tumour only	141	67 (47.5 ± 4.2 %)	16.5 ± 1.8 mths (dispersion = ± 14.8 mths)
		Difference: − 8.8 ± 5.7 %.	Difference: + 1 ± 2.5 mths.

When all cases are included one finds an average duration of life of 1 year 11 months for those cases that have obtained ovarian irradiation and 2 years 1 month for the non-castrated control cases. The difference of 2 months is of no import from statistical point of view. Improvement has occurred in about 39 % of the castrated cases and in about 48 % of the other group. The length of the period of improvement has been average $17^1/_2$ and $16^1/_2$ months respectively. A statistically significant difference is only present with regard to the number improved. The difference amounts to 9 % and speaks against the castration treatment.

As has been stated before the castrated group comprises a far greater number of advanced cases than the control group. An impaired general condition as a result of the cancer has been noted in no less than 62 % of the former group and only in 11 % of the latter. These far advanced

Table 4.

Comparison of average duration of life between castrated and non-castrated cases when only cases with an impaired general condition are included. Duration of life reckoned from operation or from the commencement of radiological treatment in respect of the inoperable cases.

	Number of cases	Deaths	Duration of life (average)
Castration only or castration + direct irradiation of tumour. Impaired general condition	101	88 (88 %)	20.5 ± 1.6 mths (dispersion = ± 15.5 mths)
Direct irradiation of tumour only. Impaired general condition	33	32 (97 %)	18 ± 3.5 mths (dispersion = ± 19.8 mths)
			Difference: + 2.5 ± 3.8 mths.

cases having as a rule been little influenced, affect the figures in an adverse manner both as regards duration of life and improvement. In the two subjoined tables will be found the result for these cases with impaired general condition.

Table 5.

Comparison of rate and duration of improvement between castrated and non-castrated cases when only cases with an impaired general condition are included. The improvement reckoned from the ovarian irradiation or from commencement of the radiological treatment in respect of the control cases.

	Number of cases	Improved	Duration of improvement (average)
Castration only or castration + direct irradiation of tumour. Impaired general condition . .	101	18 (18 ± 3.8 %)	9 ± 2.9 mths (dispersion = ± 12.4 mths)
Direct irradiation of tumour only. Impaired general condition . .	33	5 (15 ± 3.8 %)	14 ± 8.9 mths (dispersion = ± 20 mths)
		Difference: + 3 ± 5.3 %.	Difference: − 5 ± 9.4 mths.

The average duration of life for the two groups is about the same, namely 20½ and 18 months respectively. The number of improved in the two groups is very similar, namely 18 and 15 % respectively. Nor does the duration of the improvement, 9 and 14 months respectively, show any difference of any statistical significance. If reconsidering the result with regard to duration of life and improvement for the whole clinical material it will be found that the figures just given for the cases with the general condition impaired are materially below those submitted in the previous tabulation. On account of the different proportions (62 % and 11 % respectively) in which the far advanced cases with impaired general condition enter into the castrated group and in the control cases, it can be understood that no favourable effect of the ovarian irradiation has been apparent in a comparison within the whole clinical material.

Regarding the clinical character of the cases to be compared a better agreement is obtained if all those cases are eliminated in which the general condition has been stated to be impaired on account of the cancer. We then have 62 castrated and 275 non-castrated cases in which duration of life and improvement have the following appearance.

The average duration of life for the castrated cases is 2 years 5 months, for the control cases 2 years 2 months. This constitutes no statistically significant difference. The rate of improved cases in the former group is 73 % with an average duration of the improvement of 1 year 9 months.

Table 6.

Comparison of the average duration of life between castrated and non-castrated cases when only cases with good general condition are included. Duration of life reckoned from the operation or the commencement of radiological treatment in respect of the inoperable cases.

	Number of cases	Deaths	Duration of life (average)
Castration + direct irradiation of tumour. Good general condition . . .	62	33 (51 %)	29 ± 6.4 mths (dispersion = ± 36.7 mths)
Direct irradiation of tumour only. Good general condition	275	194 (70 %)	26 ± 2.0 mths (dispersion = ± 27.8 mths)
			Difference: + 3 ± 6.7 mths.

Table 7.

Comparison of rate and duration of improvement between castrated and non-castrated cases when only cases with good general condition are included. The improvement reckoned from the ovarian irradiation or from the commencement of the radiological treatment in respect of the control cases.

	Number of cases	Improved	Duration of improvement (average)
Castration + direct irradiation of tumour. Good general condition	62	45 (73 ± 5.6 %)	21 ± 2.2 mths (dispersion = ± 14.7 mths)
Direct irradiation of tumour only. Good general condition . . .	108	62 (57 ± 4.8 %)	17 ± 1.8 mths (dispersion = ± 14.3 mths)
		Difference: + 16 ± 7.4 %.	Difference: + 4 ± 2.8 mths.

The corresponding figures in the latter group are 57 % and 1 year 5 months. The rate of improvement in the castrated cases thus exceeds that of the control cases by 16 %, a difference which is statistically doubtful because it does not rise to three times the mean error. The duration of improvement is 4 months longer for the castrated group as compared with the other group, a difference which is also statistically doubtful. This comparison regarding the improvement thus seems to be in favour of castration. The differences are small, however, and impaired by relatively great mean errors. In my opinion, therefore, they scarcely bear a correct relation to the magnitude of the errors in the individual observation when so little exact factors are concerned as improvement and its duration. Add to this that the setting apart of the far advanced cases,

however careful this may have been done, can scarcely have been fully uniform in the two groups compared, a factor which also should warn us against drawing conclusions from small differences. I doubt, therefore, if one is justified in drawing any definite conclusions from the figures just submitted, unless other comparisons would point in the same direction.

It was maintained already by BEATSON that cases that could be expected to derive the greatest benefit from castration were those in which the cancer had not spread beyond the first lymphatic station, thus patients who clinically had shown either only a primary tumour or a local recurrence with or without glandular metastases in the axilla but not in other regions.

In the material of Radiumhemmet, there are no cases of primary tumour treated by castration who have not also shown distant metastases. Cases exist, on the other hand, with local recurrences, or glandular metastases in the axilla after a previous operation which have shown no further spread of the cancer beyond that. The number of such cases, however, belonging to the group with a good general condition, is only 17, thus too small to serve with any advantage a statistical purpose. Below, however, will be found the tabulated results of these cases. For comparison has been taken the rest of the castrated cases without stated impairment of the general condition, thus those cases which have presented signs of extension of the cancer beyond the first lymphatic station.

As is of course to be expected on account of the small number of cases there is no statistically significant difference between the results in the two compared groups.

In the tabulations submitted so far, no regard has been had to the age of the patients. In accordance with the theoretical speculations of ovarian irradiation a beneficial effect of this therapy, if any, should above

Table 8.

Comparison of average duration of life between cases with local recurrences or glandular metastases in the axilla and cases with signs of extension of the cancer beyond the first lymphatic station, all belonging to the castrated group with good general condition. Duration of life reckoned from the operation.

	Number of cases	Deaths	Duration of life (average)
Good general condition. Local recurrences or metastases in axilla . . .	17	8 (47 %)	27 ± 15 mths (dispersion = ± 42 mths)
Good general condition. Extension beyond axillary glands	45	25 (56 %)	29 ± 7 mths (dispersion = ± 35 mths)

Difference: − 2 ± 16.5 mths.

Table 9.

Comparison of rate and duration of improvement between cases with local recurrences or glandular metastases in axilla and cases with signs of extension of the cancer beyond the first lymphatic station, all belonging to those treated with castration with good general condition.

	Number of cases	Improved	Duration of improvement (average)
Good general condition. Local recurrences or metastases in axilla	17	12 (70 ± 7.9 %)	25 ± 4 mths (Dispersion = ± 14.2 mths)
Good general condition. Extension beyond axillary glands .	45	33 (73 ± 7 %)	20 ± 2.7 mths (dispersion = ± 14.9 mths)
		Difference: − 3 ± 10.6 %.	Difference: + 5 ± 4.8 mths.

all be noticeable in younger, still menstruating women. If still eliminating the far advanced cases with bad general condition there are among the castrated cases 24 who were 45 years of age and less at the time of irradiation of the ovaries. Of the control cases 62 patients belonged to this age-group on admission for radiological treatment. Below will be found tables comparing the results in cases with good general condition after dividing them into two age-groups, above and below 45 years.

Table 10.

Comparison of average duration of life between castrated and non-castrated cases with good general condition. The cases divided into two age-groups, 45 years and less and over 45 years respectively. Duration of life reckoned from operation or commencement of radiological treatment in respect of the inoperable cases.

	Number of cases		Deaths		Duration of life (average)	
	45 yrs and less	Over 45 yrs	45 yrs and less	Over 45 yrs	45 yrs and less	Over 45 yrs
Castration + direct irradiation of tumour. Good general condition	24	38	8 (33 %)	25 (66 %)	28 ± 6.3 mths disp. = ± 17.8 mths	29 ± 8 mths disp. = ± 40 mths
Direct irradiation of tumour only. Good general condition	62	213	49 (79 %)	145 (68 %)	20 ± 2 mths disp. = ± 13.4 mths	31 ± 2.6 mths disp. = ± 31.2 mths
					Difference: + 8 ± 6.6 m.	Difference: − 2 ± 8.4 m.

Table 11.

Comparison of rate and duration of improvement between castrated and non-castrated cases with good general condition. The cases divided into two age-groups, 45 years and less and over 45 years respectively. Improvement reckoned from castration or from commencement of radiological treatment in respect of the control cases.

	Number of cases		Improved		Duration of improvement (average)	
	45 yrs and less	Over 45 yrs	45 yrs and less	Over 45 yrs	45 yrs and less	Over 45 yrs
Castration + direct irradiation of tumour. Good general condition	24	38	17 71 ± 9.8 %	28 74 ± 7.1 %	18.5 ± 1.9 mths disp. = ± 7.9 mths	22.5 ± 3.8 mths disp. = ± 17.6 mths
Direct irradiation of tumour only. Good general condition	29	79	19 66 ± 8.8 %	43 54 ± 5.6 %	22 ± 3.5 mths disp. = ± 15.2 mths	13 ± 2.1 mths disp. = ± 13.9 mths
			Diff.: +5 ± 12.8 %.	Diff.: +20 ± 9 %.	Diff.: −3.5 ± 4 m.	Diff.: +9.5 ± 3.9 m.

The average duration of life for the younger castrated group is 2 years 4 months, for the younger non-castrated cases 1 year 8 months. The difference of 8 months is here too near its mean error (± 6.6 months) to justify any definite conclusion. As impaired we find 71 % of the castrated younger patients with an average duration of the improvement of 18½ months and among the non-castrated younger patients 66 % improved with a period of improvement of 22 months. The differences here are not statistically significant. Among patients above 45 years the average duration of life is 29 months for the castrated cases and 31 months for the non-castrated patients, thus about the same. Among this older group the castrated cases show a rate of improvement of 74 % and the non-castrated cases 54 %. It will be seen, therefore, that we have a statistically doubtful difference here of 20 % in favour of those treated by castration. With regard to the duration of this improvement there is an excess of 22½ months for those castrated as against 13 months for those solely treated by irradiation of the tumour (a difference of 9½ months). The difference here does not quite reach three times the mean error.

With regard to improvement and its duration there are thus somewhat more favourable figures for the castration treatment among the older patients than among the younger ones when compared with the non-castrated material. In absolute figures, however, the results in the castrated group are about the same for the older as for the younger pa-

tients. The difference obtained, therefore, is due to the younger group of the control cases showing a better rate and duration of the improvement than the older group. This is of course contrary to general experience which goes to show that the prognosis in cancer mammae is on the whole better for older patients than for younger ones, even in the case of palliative treatment. This unexpected result in what concerns the control cases may, however, be explained by the fact that the number of cases, on account of these having been divided into different groups, has been relatively small. The fact, previously pointed out, that it is difficult to give an unbiassed opinion as to improvement and its duration in the individual case, will therefore have a great influence.

As a measure of improvement after operative castration LETT gave a figure of about 23 %. In patients under 50 years of age improvement ensued in 41 %. The material of Radiumhemmet shows 73 % improved and 71 % in cases under 46 years of age. No importance can be attached to the fact that these figures are higher than those submitted by LETT, as the far advanced cases have not been included and direct irradiation of the tumour has also been given. On the other hand, it is worthy of note that the younger cases do not show that tendency to relative improvement which is so definitely in evidence in LETT's statistics. Nor does the younger group show any more favourable figures with regard to duration of life and of improvement. It must again be emphasized, however, that the number of cases belonging to the younger group at Radiumhemmet is comparatively small.

So far we have only been speaking of the possible beneficial effect of ovarian irradiation. For a fair estimation of the value of this therapy, however, we must also examine whether it can be considered entirely free from danger. Several patients develop rather a well-marked roentgen nausea. It might of course be conceived that such a temporary impairment of strength would result in a lessening of the resistance against cancer. I have found no case among this material in which there was a more acute progress of the disease in direct association with the ovarian irradiation. Great difficulties are met, however, when we come to estimate the causal connection, more so as the ovarian irradiation has in most cases just been given during a stage of continuous aggravation of the condition. In the hope to find something that could help one to form an unbiassed judgment of this question I have inquired as to how many cases died within 3 months after the ovarian treatment or after the beginning of the radiological treatment in respect of the control cases. If excluding the far advanced cases with a bad general condition there are 4 patients of the 62 castrated cases (6.5 ± 3.1 %) and 3 out of the 108 noncastrated cases (2.8 ± 1.6 %) who died within 3 months. These figures do not of course constitute any evidence in support of the

assumption that the ovarian irradiation would have any direct harmful effect.

Conclusions

1. Among 16 cases of cancer mammae in a far advanced stage of the disease and who all had distant metastases, castration by roentgen rays did not prove to yield any obvious result in the form of improvement or prolonged duration of life. No direct irradiation of the tumour was given in these cases.

2. The figures relating to the average duration of life, the number of improved patients and the average duration of the improvement for the whole number of castrated cases (163) do not exceed corresponding figures for the non-castrated control cases which, with regard to the duration of life, comprise 308 cases and with regard to the improvement 141 cases. The castrated material, however, includes a very much greater number of cases with an impaired general condition on account of cancer (62 % against 11 %).

3. A comparison among these cases with the general condition impaired yield on the whole a similar result for the castrated as for the non-castrated cases, worse for each group than for the whole material.

4. When only the cases with a good general condition are included no difference exists as between the castrated and the control cases with regard to the duration of life. On the other hand, with regard to rate and duration of improvement there is a difference of 16 % and 4 months in favour of castration. These differences are, however, from statistical point of view, doubtful while they do not reach three times their mean errors. It is questionable, however, whether from these small differences one is justified in drawing any definite conclusions as regards the value of castration for the group in question.

5. Among cases with a good general condition those who only have had local recurrences or glandular metastases in the first lymphatic station have not showed any better results as regards duration of life and improvement than those evidencing signs of a more generalised extension of the cancer. The number of cases, however, in these two groups is only 17 and 45 respectively which considerably reduces the value of the statistical comparison.

6. Among cases with a good general condition those of 45 years and less have had about the same average duration of life and showed the same rate and duration of the improvement as those above 45 years of age when the castration treatment was given. Nor is there any difference with regard to the same factors between the castrated and the non-castrated cases within the younger group of cases. In the group above

45 years, on the other hand, there is a difference — statistically doubtful — with regard to the improvement in this way that the castrated cases show a rate of improvement which exceeds that of the control cases by 20 % and an excess in the average duration of improvement amounting to 9½ months.

When dividing the cases into two age-groups it is found that the somewhat better result as regards improvement in the castrated cases, as compared with that of those also with good general condition treated solely with direct irradiation of the tumour, is almost exclusively to be found in patients over 45 years of age.

This would mean, therefore, that the only group where there has really been an obvious favourable effect of the castration treatment as regards rate and duration of improvement is that made up of patients with a satisfactory general condition and above 45 years of age. Most of the patients of this group had passed the climacteric age when the castration treatment was given. The result is therefore surprising as it is usually considered that only menstruating women can have any use of castration in cancer mammae. When adding to this that the control cases show a greater rate and a longer duration of the improvement among the younger cases than among the older ones — which is of course also contrary to what is generally found as regards the prognosis of treatment in younger and older cases of cancer mammae — one must hesitate before drawing any conclusions from the present tabulation as regards the value of the castration treatment. The difference in the results just mentioned between the younger and the older group of the control cases, which of course has mainly occasioned the difference in favour of castration, is likely to have arisen in consequence of the uncertainty that must always be attached to the individual observations, not only with regard to the duration of the improvement but also, in cases with skeletal metastases only, with regard to amelioration of symptoms and an improved general condition. This source of error is the more significant as the material has been divided into groups of relatively small numbers.

In the author's opinion, therefore, the conclusions may be summarised as follows:

No definite proofs have been forthcoming in support of the favourable effect of castration in cases of cancer at Radiumhemmet. Yet this material includes very few of such cases in which one has the greatest reason to expect a favourable effect, if forthcoming at all, namely still menstruating women who do not give evidence of any spread of the cancer beyond the first lymphatic station.

There is no evidence of the castration treatment having affected the course of the disease in any harmful way.

SUMMARY

After a brief historical review the author describes the theoretical principles of castration in cancer mammae. A statistical account is then given of 163 cases of cancer mammae castrated by roentgen at Radiumhemmet during the period 1922—1928. In a small number of cases one gave no direct irradiation of the tumour, in the other cases the castration treatment was combined with roentgen- or radium irradiation of tumours or metastases. In cases solely treated by castration which were all in a far advanced stage one found no favourable effect of the treatment. The results obtained in cases treated by castration as also by direct irradiation of the tumour have been estimated in comparison with those cases which were given only direct irradiation of the tumour. The comparison shows that the ovarian irradiation had no beneficial effect on the duration of life. With regard to rate and duration of the improvement one finds — after exclusion, from both groups, of cases with impaired general condition on account of the cancer — slightly better result in the group treated by castration as compared with the non-castrated control cases where patients above 45 years are considered. In the author's opinion no certain conclusions can be drawn anyhow as regards the value of the treatment and proofs are submitted in support of his view. Yet the material of Radiumhemmet includes very few of those cases in which one is above all justified in hoping for a favourable effect, namely still menstruating women who do not give evidence of any spread of the cancer beyond the first lymphatic station. No evidence has been forthcoming to show any harmful effect of the castration treatment in the course of disease.

ZUSAMMENFASSUNG

Nach einem kurzen geschichtlichen Überblick beschreibt Verf. die theoretischen Prinzipien der Kastrierung bei Cancer mammae. Er gibt dann einen statistischen Bericht über 163 Fälle von Cancer mammae, die am Radiumhemmet in der Periode von 1922—1928 durch Röntgenbestrahlung kastriert wurden. In einer kleinen Zahl von Fällen wurde keine direkte Bestrahlung des Tumors vorgenommen, in den anderen Fällen war die Kastrierungsbehandlung mit Röntgen- oder Radiumbestrahlung von Tumoren oder Metastasen kombiniert. In Fällen, bei welchen sich die Behandlung ausschliesslich auf Kastrierung beschränkte — sie befanden sich alle in einem weit vorgeschrittenen Stadium — fand man keine günstige Wirkung der Behandlung. Die Resultate in Fällen, bei welchen sowohl Kastrierung als auch direkte Bestrahlung des Tumors vorgenommen worden war, wurden mit denen der Fälle verglichen, bei welchen man nur den Tumor direkt bestrahlt hatte. Der Vergleich zeigt, dass die Bestrahlung der Ovarien keine nützliche Wirkung betreffs der Lebensdauer hat. Was das Frequenzverhältnis und die Dauer der Besserung betrifft, so finden wir — nachdem die Fälle mit Herabsetzung des Allgemeinzustandes durch das Karzinom aus beiden Gruppen ausgeschaltet waren — in der kastrierten Gruppe etwas bessere Resultate als in den nicht kastrierten Kontrollfällen, soweit es sich um Patientinnen über 45 Jahre handelt. Nach Ansicht des Verfassers lassen sich doch keine sicheren Schlüsse in Bezug auf den Wert der Behandlung ziehen, und er führt Beweisgründe als Beleg für seine Auffassung an. Allerdings enthält das Material des Radiumhemmets sehr wenige von denjenigen Fällen, bei welchen man vor allem zur Hoffnung auf eine

günstige Wirkung berechtigt wäre, nämlich solche noch menstruierender Frauen, bei welchen keine Zeichen einer Ausbreitung des Karzinoms über die regionären Lymphdrüsen hinaus vorliegen. Beweise für eine nachteilige Wirkung der Kastrationsbehandlung auf den Verlauf der Krankheit haben sich nicht ergeben.

RÉSUMÉ

Après un bref historique de la question, l'auteur expose les principes théoriques de la stérilisation dans le cancer du sein. A cette occasion, il communique la statistique de 163 cas de cancer mammaire stérilisés par les rayons Roentgen à Radiumhemmet, de 1922 à 1928. Dans une minorité de cas, il ne fut procédé à aucune irradiation directe du néoplasme; dans les autres cas, le traitement stérilisateur fut combiné avec une irradiation de la tumeur ou de ses métastases, soit par les rayons Roentgen, soit par le radium. Dans les cas exclusivement traités par la stérilisation, qui étaient tous à un stade très avancé, on n'obtint du traitement aucun résultat favorable. L'auteur établit une comparaison entre les résultats obtenus par la stérilisation combinée avec une irradiation directe de la tumeur et ceux que donne la seule irradiation directe du néoplasme. On peut conclure de cette comparaison que l'irradiation ovarienne n'exerce aucune action favorable sur la survie. En ce qui concerne par contre l'amélioration réalisée, on constate — défalcation faite, dans les deux catégories, des cas où l'état général est gravement atteint du fait de la tumeur — des résultats légèrement supérieurs chez les malades ayant subi la stérilisation, par comparaison avec ceux qui n'ont été l'objet d'aucun traitement de cette nature, cette constatation s'appliquant à des malades de plus de 45 ans. De l'avis de l'auteur, on ne peut en aucune façon tirer de conclusion certaine en ce qui concerne la valeur du traitement et il rend compte d'expériences à l'appui de cette manière de voir. Le matériel dont on dispose au Radiumhemmet ne comprend encore que peu de cas dans lesquels on puisse espérer un résultat favorable, c. à d des cas de femmes n'ayant pas encore atteint la ménopanse et ne présentant aucun signe d'extension de la tumeur en dehors de la première étape lymphatique. Rien n'a permis de supposer une action défavorable de la stérilisation sur l'évolution du néoplasme.

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AUS DER RÖNTGENDIAGNOSTISCHEN ABTEILUNG DES ALLGEMEINEN UND SAHLGRENSCHEN KRANKENHAUSES, GOTENBURG

EINIGE RÖNTGENOLOGISCH BEOBACHTETE FÄLLE VON MAGENTUBERKULOSE

von

Axel Renander

(Tabula LII)

Trotz des reichlichen Vorkommens von Lungen- und Darmtuberkulose ist die Magentuberkulose ein relativ seltenes Leiden. In GRUSDEWS grosser Statistik fanden sich unter 18.593 Sektionen nur 23 Fälle mit Tbc-Veränderungen im Magen, d. h. 0.12 % aller Sektionsfälle. Bei Sektion mit Tbc behafteter Individuen wurde Magentuberkulose von GLAUBITT in 2.1 %, von LETULLE in 0.6 und KUNDRAT in 0.5 % gefunden.

In der Literatur unterscheidet man zwischen *primärer* und *sekundärer* Magentuberkulose und bezeichnet Fälle, wo sonst keine tuberkulösen Veränderungen konstatiert werden konnten, als primäre. Diese Gruppierung lässt sich kaum streng durchführen, weder klinisch noch pathologisch-anatomisch, weil es unmöglich sein kann, einen verborgenen Primärherd zu diagnostizieren. Die Grenze zwischen primärer und sekundärer Magentuberkulose muss also sehr willkürlich werden, je nach der Gründlichkeit und diagnostischen Geschicklichkeit des betreffenden Arztes. Klinisch kann es jedoch berechtigt sein, eine Scheidung der primären von den sekundären Fällen zu versuchen, oder in der letzteren Gruppe Fälle zu sondern, wo die Magentuberkulose das Krankheitsbild dominiert, weil die Therapie eventuellen anderen tuberkulösen Manifestationen einigermassen angepasst werden muss.

Die Magentuberkulose ist im Vergleich mit der Darmtuberkulose selten, trotzdem man erwarten sollte, dass der Magen in gleich hohem Grade der Infektion ausgesetzt sei. Von primärer Tuberkulose im Magen sind nur etwa 20 Fälle in der Literatur beschrieben. Obgleich Tuberkulöse in den Endstadien reichlich bazillenhaltiges Sputum hinunterschlucken, kommen Tbc-Veränderungen im Magen nur bei ca. 0.5 % dieser Fälle vor. Dieses Missverhältnis zwischen Exposition und Infektion führte zu vielen Theorien darüber, welche anatomischen und physiolo-

gischen Verhältnisse die Ursache der ausgeprägten Resistenz des Magens gegen die Tbc-Infektion sein könnten. VIRCHOW, KLEBS, ROKITANSKY, CURSCHMANN u. a. sind der Ansicht, dass die Erklärung im spärlichen Vorkommen von *Lymphfollikeln* im Magen liege, und weisen als Stütze hierfür darauf hin, dass die Prädilektionsstellen im Darm, wie z. B. das Ileum, an Lymphfollikeln besonders reich sind, und dass die Magentuberkulose am häufigsten im Pylorusgebiet lokalisiert ist, wo Follikel relativ am reichlichsten vorkommen. WILMS, BLAS, HANAU, HOLZMANN, WEINBERG vertreten eine andere Auffassung und messen dem Lymphapparat überhaupt keine Bedeutung für die Entstehung der Tbc-Infektion im Magen bei. WILMS sah, wenigstens bei der hämatogenen Miliartuberkulose eine Menge Knötchen in allen Schichten der Magenwand, ohne dass der lymphatische Apparat im mindesten affiziert war. MARFAN, RICARD und CHEVRIER, BLAS, ORTH sind der Ansicht, dass *Schleimhautdefekte* eine grosse Rolle für die Entstehung der Infektion spielen, wobei der letztgenannte Verfasser seine Auffassung auf Tierexperimente stützt. Viel ist auch über eine schützende Einwirkung der freien *Salzsäure* im Magen geschrieben worden. Die meisten Verfasser scheinen jedoch nunmehr der Ansicht zu sein, dass der Magensaft nicht imstande ist, eine verhindernde Einwirkung auf die Entwicklung der Tbc-Bazillen im Magen auszuüben (BAUMGARTEN, CARRIÈRE, MANDERCANS u. a.). Hierfür spricht ja auch der Umstand, dass sich bei Phthisikern so selten eine Magentuberkulose entwickelt, trotzdem viele Verfasser (BRIGER, ZIMMERMANN) bei ihnen minderwertigen Magensaft nachwiesen. Andere Faktoren, die als Schutz gegen Infektion des Magens angeführt wurden, sind der *Magenschleim* (ARLOING, GOSSMANN) und die normale *Motilität* des Magens (CURSCHMANN, GOSSMANN).

Man nimmt an, dass die Infektion auf folgenden Wegen erfolgen könne:

1) per os,
2) durch die Blutbahnen,
3) durch die Lymphbahnen,
4) aus der Serosa.

Bei Infektion *per os* kommen die Bazillen entweder mit der Nahrung in den Magen (bei primärer Magentuberkulose) oder mit dem eigenen Sputum. Die *hämatogene* Infektion kommt durch bazilläre Embolie zustande, wie bei Miliartuberkulose. Experimentell ist die hämatogene Entstehungsweise durch ARLOING bewiesen worden. Die *lymphogene* Infektionsweise wird am eifrigsten von VIRCHOW, KLEBS und ROKITANSKY verfochten. Da der Lymphstrom von der Mukosa zur Serosa geht, muss eine solche Infektion immer in retrograder Richtung vorsichgehen, gewöhnlich von infizierten perigastralen Drüsen. Bei starker Blockierung

des Lymphnetzes infolge von Adenitiden und Perigastritiden ist die Möglichkeit einer regionären Stagnation in den Lymphbahnen und damit einer retrograden Infektion gegeben. Von der *Serosa* aus kann die Infektion entweder per continuitatem geschehen (ungewöhnlich) oder per contiguitatem (von Lymphdrüsen, Milz, Gallenblase usw.).

Von der *lokalen Magentuberkulose* sind folgende Formen zu unterscheiden:

1) die ulzeröse,
2) die hypertrophische und
3) die entzündliche Form (PONCET und LERICHE).

Ausser diesen Formen sind in der Literatur beschrieben

a) Einfache Gastritis beim Phthisiker,
b) Multiple Erosionen und Ulzera in der Schleimhaut, gewöhnlich im Terminalstadium bei Phthisikern,
c) Akute miliäre Aussaat,
d) Von angrenzenden Organen ausgegangene Magentuberkulose,
e) Eine extragastrale Form mit sekundärer Kompression des Magens.

Die *ulzeröse* Form beginnt gewöhnlich in der Submukosa, von der das Granulationsgewebe sich in das Lumen hineinfrisst. Bei Zerfall des Gewebes entstehen dann unterminierte, unregelmässige Geschwüre mit verdickten Rändern. Selten reicht der Geschwürsgrund tiefer als zur Submukosa. Epitheloidtuberkeln kommen nicht häufig vor und nur in unmittelbarer Nähe der Substanzverluste. Die Geschwüre breiten sich gewöhnlich annulär aus und rufen einen stenosierenden Ring hervor. In schweren Fällen können sie so gut wie den ganzen Magen einnehmen (FISCHER-DEFOY). Bemerkenswert ist, dass es niemals gelang, Bazillen in der Magenwand nachzuweisen.

Die *hypertrophische* Form äussert sich als diffuse Wandverdickung mit Infiltraten in der Submukosa, welche den Canalis meist ringförmig stenosieren. Die Mukosa ist gewöhnlich intakt.

Ausserdem haben PONCET und LERICHE eine von vielen Verfassern bezweifelte *entzündliche* Form beschrieben, die durch Tbc-Toxine verursacht sein soll. Je nach der Lokalisation in Mukosa oder Submukosa würde sie eine adenomatöse Proliferation hervorrufen, mitunter mit Polypen, oder eine Linitis-plastica-ähnliche diffuse sklero-inflammatorische Infiltration.

Komplikationen finden sich bei Magentuberkulose relativ selten. *Blutungen* sind wegen Thrombosierung der angrenzenden Gefässe ungewöhnlich und *Perforationen* kommen wegen der reichlichen reaktiven peritonealen Adhärenzen gleichfalls selten vor. Mitunter wurden *Fistelbildungen* beobachtet (ins Duodenum, Kolon usw.). Oft bilden sich bedeutende *plastische Peritonitiden* und *Adenopathien*, die grosse peri-

gastrale Tumorbildungen hervorrufen. Eine gewöhnliche Komplikation der hypertrophischen Form ist die *narbige Stenose.*

Die *Symptomatologie* ist bei Magentuberkulose sehr wenig charakteristisch. Die tuberkulösen Geschwüre geben oft dieselben Symptome wie die einfachen Magengeschwüre. *Schmerzen* sind bei den Pylorusstenosen relativ konstant, ebenso *Erbrechen. Hämatemesis* kommt selten vor. Gewöhnlich besteht eine *Hypochlorhydrie* oder Anazidität. Für recht charakteristisch halten die meisten Verfasser anhaltende *Diarrhöen*, die gegen jegliche Therapie sehr resistent sind. Auch bei der Operation kann es schwer sein, die Diagnose zu stellen. MELCHIOR ist der Ansicht, dass ein gleichmässiger Tumor von nicht besonders fester Konsistenz für Tbc charakteristisch sei. Wo es schwierig ist, den Tumor von einem Karzinom zu unterscheiden, spricht nach MELCHIOR eine reichliche Peritonealaussaat von Knötchen bei Fehlen von Kachexie für Tbc. *Die Prognose* ist in den meisten Fällen schlecht. Man hat jedoch Patienten nach frühen Eingriffen lange, bis zu 15 Jahren, beobachten können, ohne dass Rezidiven eintraten. *Resektion*, wenn sie mit Rücksicht auf den Allgemeinzustand und rein operationstechnisch möglich ist, wird jetzt entschieden als die beste Therapie betrachtet, und der Gastroenterostomie oder einer konservativen allgemeinen Therapie vorgezogen.

Kasuistik

Fall 1. S. E. J., 52-jährige Frau. 24. VII. 29 Aufnahme ins Allg. und Sahlgrensche Krankenhaus. Ein paar Jahre vor der Aufnahme hatte Pat. eine zeitlang diffuse Bauchbeschwerden mit Druckgefühl im Zwerchfell nach den Mahlzeiten. Kein Aufstossen oder Erbrechen. Magen und Duodenum zeigten damals bei der Untersuchung normale Verhältnisse. Dann war Pat. gesund, bis sie einen Monat vor der Aufnahme begann, unmittelbar nach den Mahlzeiten Schmerzen im Zwerchfell zu bekommen. Ausserdem Aufstossen, aber kein Erbrechen. Nach dem Aufstossen verschwanden die Schmerzen. Keine Schmerzen zu anderen Tageszeiten. Der Zustand verschlechterte sich in der Zeit vor der Aufnahme. Entleerung normal. Appetit schlecht. Pat. glaubt, dass sie in der letzten Zeit abgemagert sei. Status bei der Aufnahme: Guter Allgemeinzustand. Recht blass. Klagt nicht über Schmerzen. *Cor:* o. B. *Pulm.:* physikal. o. B. *Röntgenuntersuchung:* (LIND). Im Parenchym, vor allem im Spitzenteil und im I 1 sieht man einige verkalkte Herde. Aller Wahrscheinlichkeit nach handelt es sich um ältere Tbc.-Verkalkungen. *Abdomen:* Im Epigastrium bei tiefer Palpation diffus Empfindlichkeit. Keine palpable Resistenz. Der Bauch weich und nicht empfindlich. Hämoglobingehalt 70 %. Rote Blutkörperchen 4,000,000, weisse 9,000, davon 40 % Lymphozyten, 58 % neutrophile und 1 % eosinophile Leukozyten. 1 % Übergangsformen. Rest-N 37 mg %. Weber in den Fäzes neg. Senkungsreaktion 34 mm in 1 Std.

Röntgenuntersuchung (RENANDER): Langgestreckter J-förmiger Magen (Fig. 1). Korpus schmal. Vom Angulus und aufwärts sieht man das Korpus auf einem gut 5 cm langen Gebiet manschettenförmig ungefähr bis zur Hälfte der normalen

Lumenweite verengt. Durch die regionäre konzentrische Verengung kommt eine relative Stenose zustande. Bei Palpation schienen die Konturen im veränderten Gebiet starr zu sein. Bei Kompression (Fig. 2) sieht man mehrere gleichmässig rundliche, scharf abgegrenzte unregelmässige Verdünnungen in der stenosierten Partie. Das Kontrastmittel bildet ein steifes grobmaschiges Netzwerk zwischen den Verdünnungen. Auf den Radiogrammen erscheint die Konturierung im veränderten Gebiet starr, sie ist aber scharf gezeichnet und relatif gleichmässig. Träge, unregelmässige Kanalisperistaltik. Bulbus duodeni hypotonisch, weist aber keine konstanten Deformierungen auf. Keine Retention nach 4 Stunden. Die Röntgenuntersuchung zeigte im unteren Teil des Corpus ventriculis auf einem ca. 5 cm langen Gebiet eine manschettenförmige Infiltration. *Operation* 28. VIII. 29. (SUNDIN). Schnitt im Epigastrium. Der Magen ist lang und schmal und lässt sich leicht hervorziehen. Keine Drüsen palpabel. Ungefähr 10 cm über den Pylorus wird ein weicher Tumor palpiert, der ein ca. 7—8 cm grosses Gebiet des Magens einnimmt. Resektıon des Tumors nach Polya, Übernähung des Duodenalstumpfes in 3 Etagen. Da der übrige Teil des Magens sich recht schwer hervorziehen liess, und die Suturen in dem ödematösen Gewebe leicht durchschnitten, wurde eine Fistel nach Witzel angelegt mit einem Zigarettendrän gegen die terminolaterale Enteroanastomose. Sutur. *Mikroskopische Untersuchung* des Resektionspräparates (FORSELIUS): Kein echter Tumor, sondern ein ulzerös entzündlicher Prozess mit starker Verdickung und schwieliger Umwandlung der Submukosa. Wahrscheinlich handelt es sich wohl um den Rest einer Gastritis phlegmonosa, zu beachten ist aber, dass an einer Stelle Granulationen von tuberkuloidem Typus vorgefunden wurden, obgleich sie nirgends Bilder vollständig ausgebildeter Tuberkeln gaben. Ich kann unter diesen Umständen nicht die Möglichkeit ausschliessen, dass eines der seltenen Tbc.-Ulzera im Magen der ausgebreiteten Entzündung von nicht spezifischem Typus zu Grunde lag. Heilungsverlauf normal. Am. 12. X. wurde Pat. geheilt und symptomfrei entlassen.

Fall 2. A. O. A., 43-jährige Frau. Am 4. XII. 29 Aufnahme in das Carlandersche Krankenheim. Magenbeschwerden seit nicht gar langer Zeit. Heftige Schmerzen im Epigastrium von mehr kontinuierlichem Typus; in der letzten Zeit Erbrechen. Stuhlentleerung träge. Probefrühstück ergab keine freie HCl. TA 18. Weber in den Fäzes neg. Subfebrile Temp. *Cor:* Systolisches blasendes Geräusch. P II akzentuiert. *Pulm.:* Physikal. o. B. *Röntgenuntersuchung* der Lungen (ODQVIST) zeigte einige kleinere Verkalkungen medial im rechten Oberlappen und in beiden Hili. Lateral vom rechten Hilus ausserdem einige fibröse Züge. Freie Beweglichkeit der Zwerchfellkuppel. Tbc. sanat. Keine Zeichen eines frischen Prozesses. Der *Magen* (Fig. 3) hypotonisch. Der Kanalis tütenförmig in der Richtung zum Pylorus zusammengezogen. Keine normale Peristaltik beobachtbar. Die Konturen in diesem Teil des Magens starr, unveränderlich. Der Bulbus duodeni bleibt kontinuierlich ausgefüllt. Impression an der Pars sup. Nach 4 Stunden keine Retention. Es liegt hier wahrscheinlich eine Infiltration der Magenwand im Kanalis vor (Scirrhus?). *Operation* 7. XII. (LUNDBERG). Schnitt in der Mittellinie oberhalb des Nabels. Im Kanalis ist nächts dem Pylorus ein Magentumor zu palpieren, der das Lumen nicht zu stenosieren scheint. Um den Pylorus, besonders nächst der Curvatura major und längs dieser vergrösserte, harte, palpable Drüsen. Ebenso finden sich solche im Omentum minus hinunter zur Aorta. An der Magenoberfläche sehr verdächtige Verbreitung von Tumorgewebe auf dem Wege der Lymphwege. Radikale Entfernung wurde für ausgeschlossen gehalten. Man machte deshalb nur eine hintere Gastroenterostomie durch eine Spalte im

Mesokolon, wobei eine Drüse aus der Curv. major zur Untersuchung entnommen wurde. Der Magen und seine Umgebung waren auffällig stark ödematös. Sutur der Bauchwunde. *Mikroskopische Untersuchung* der exstirpierten Drüse (FORSELIUS): Kein Karzinom in der Drüse, dagegen typische frische Tuberkeln. Nach der Operation bekam die Patientin eine Thrombose im rechten Bein, konnte aber am 2. II. 1930 geheilt entlassen werden, hatte guten Appetit und einen recht guten Allgemeinzustand. Am 28. III. teilte der Mann der Pat. mit, dass sie gut isst und eigentlich keine Beschwerden hat. Ihr Körpergewicht nimmt jedoch nicht nennenswert zu.

Fall 3. J. L., 69-jähriger Oberlotse. Am 7. X. 1926 Aufnahme in das Krankenhaus in Skellefteå. Aus der Krankengeschichte: Seit 25 Jahren periodische tardive Schmerzen und Hungerschmerzen. In der Regel träger Stuhl. Mitunter saures Aufstossen und Sodbrennen. Im Jahre 1919 war er unter der Diagnose Ulcus duodeni im hiesigen Krankenhaus in Behandlung. Probefrühstück: Freie HCl 18, TA 38. Weber in den Fäzes neg. Der vorgeschlagenen Operation wollte er sich nicht unterziehen. Am 11. III. 1925 suchte Pat. die Poliklinik auf. Röntgenaufnahme des Magens und Duodenums gab damals ein negatives Resultat. Jetzt im letzten Jahre ständige Beschwerden, die periodenweise besonders heftig sind. Keine augenfällige Abmagerung. Stuhl in der letzten Zeit o. B. Status bei der Aufnahme: Allgemeinzustand etwas herabgesetzt. Pat. ist recht mager. Man bekommt den Eindruck, dass er schwer unter seinen Magenbeschwerden leidet. *Cor:* Dumpfe Töne. Sonst o. B. Blutdruck 140 mm Hg. *Pulm.:* o. B. Der *Bauch* eingezogen. Augenfällige Druckempfindlichkeit im Epigastrium, 3—4 Querfinger oberhalb des Nabels in der Mittellinie und gleich rechts davon. Keine palpable fluktuierende Resistenz. Per rectum nichts Pathologisches zu konstatieren. Senkungsreaktion 4 mm nach 1 Stunde. Im Harn kein Alb. Einzelne weisse Blutkörperchen. Keine Bakterien. *Röntgenuntersuchung* (LUNDBERG): Siehe Fig. 4. Bei der Durchleuchtung sieht man den etwas kurzen Magen nach rechts fixiert. Die Peristaltik tief und kräftig. Die Curv. maj. des Bulbus starr, die Pylorusmündung nach dieser Seite verschoben. Bei Untersuchung der Platten sieht man eine Veränderung am Bulbus. Die Kontur war nämlich auf den 4 Exponierungen vollkommen unverändert geblieben. Keine 4-Stunden-Retention. *Op.* 12. X. 26. (LUNDBERG). Schnitt in der Mittellinie. Um das Duodenum einige ältere Adhärenzen, die Gallenblase hinuntergezogen. Die Adhärenzen wurden gelöst. Im Pylorus an der Curv. maj.-Seite eine kleine Verdickung zu palpieren. Man beschloss deshalb, Resektion zu machen. Der Magen wurde vom Omentum gelöst, und das Duodenum freipräpariert. Canalisteil und Pylorus wurden entfernt. Durchbrennung von Magen und Darm mit dem Diathermiemesser. Die Enden wurden im unteren Teil des Magenschnittes mit dem Duodenum verbunden. Vernähung der Omentumöffnung. Unbedeutende Blutung. Sutur der Bauchwunde. In dem beseitigten Magenteil war kein Geschwür zu sehen, dagegen fühlte man dicht am Pylorus einen kaum erbsengrossen, beweglichen kleinen Tumor, der eine gelatinöse Schnittfläche zeigte. *Mikroskopische Untersuchung* des Resektionspräparates am 19. X. 1926 (WILTON): Gastritis purulenta (Gastr. ulcerosa). In dem eingesandten Stück besteht eine stark ausgesprochene Gastritis mit purulenter Infektion und Zerstörung der Drüsenschläuche. Massen von Eiterkörpern im Lumen und in der interstitiellen Substanz. Ein sicheres Ulkus war nicht zu finden, es dürfte aber höchst wahrscheinlich doch ein solches vorliegen. 6. XII.: Gastritis tuberculosa et purulenta. In mehreren Schnitten aus der Schleimhaut wurden typische miliäre Tbc.-Herde mit Riesenzellen und epitheloiden Zellen

angetroffen. Die Magenschleimhaut zeigt sonst eine purulente Gastritis. Während der Heilung bekam Pat. eine Iridozyklitis. Zur Zeit der Entlassung am 26. XI. 26 keine eigentlichen Beschwerden. Bei späteren Untersuchungen, zuletzt im März 1930, keine Zeichen von Rezidiven.

Ausser diesen drei Fällen von Magentuberkulose gelang es Verf., 2 weitere Fälle zu finden, den einen aus dem Sahlgrenschen Krankenhause, den anderen aus dem Gotenburger Kinderkrankenhause. Diese beiden Fälle sind indes nicht in die vorliegende Kasuistik aufgenommen, weil keine Röntgenuntersuchung des Magens ausgeführt worden war. Der erstere von ihnen sowie Fall 1 meiner Kasuistik werden später von Dr. SUNDIN in der Acta chirurgica Scandinav. vorwiegend vom chirurgischen Standpunkte besprochen werden. Für die mir zur Verfügung gestellten Fälle möchte ich den Herren Dr. JOHANSSON, LUNDBERG, und WALLGREN meinen herzlichen Dank aussprechen.

Fall 1 betrifft eine ulzeröse Magentuberkulose mit einer manschettenförmigen, den unteren Teil des Korpus umgreifenden Infiltration. Bei mikroskopischer Untersuchung fand man in dem eingesandten Stück nur an einer Stelle Granulationen von tuberkuloidem Typus. Dies stimmt auch mit der von GOSSMANN gemachten Beobachtung überein, dass Epitheloidtuberkel in der Schleimhaut recht selten vorkommen. Mikr. wird das Bild von der Gastritis beherrscht. Bei Palpation wies die Infiltration die charakteristische gleichmässige, teigige Konsistenz auf. In *Fall 2* ist die Diagnose Tbc. ventriculi allerdings nicht mikroskopisch verifiziert, weil der Kanalistumor bei der Operation für ein inoperables Karzinom gehalten und deshalb unberührt gelassen worden war. Aber nach dem makroskopischen Aussehen des Tumors, der teigigen Konsistenz und den sehr reichlichen mesenterialen und retrogastralen Drüsen, die, wie mikroskopische Untersuchung zeigte, frische Tuberkeln enthielten, muss man die Diagnose gemäss den Erfahrungen MELCHIORS für gesichert halten. In *Fall 3* gab der bei der Operation angetroffene erbsengrosse Tumor in Endteil des Kanalis mikroskopisch das typische Bild eines Tuberkuloms. Auch hier dominierten die Zeichen von Gastritis im mikroskopischen Bilde.

Die Magenbeschwerden waren in allen 3 Fällen dominierend, und es wäre deshalb berechtigt, sie vom klinischen Standpunkte als primäre Magentuberkulosen einzureihen. In Fall 1 und 2 wurden indes röntgenologisch alte verkalkte Herde in den Lungen nachgewiesen, obgleich sich keine klinischen Anhaltspunkte für Lungentuberkulose gefunden hatten. Pathologisch-anatomisch dürfte es deshalb nicht vollständig berechtigt sein, die Fälle zu den primären zu zählen. Bei vielen von den in der Literatur als primäre Magentuberkulose beschriebenen Fällen dürfte diese Diagnose jedoch einer näheren Untersuchung kaum standhalten. Oft war beispielsweise keine Röntgenuntersuchung der Lungen gemacht worden. Wäre eine solche in Fall 1 und 2 unterlassen worden, so hätten diese Fälle, da die physikalische Untersuchung keine Anhaltspunkte für

Lungentuberkulose gab, gleich vielen in der Literatur beschriebenen, zu den primären gerechnet werden können. Man dürfte sich nun darauf beschränken müssen, sie vom klinischen Standpunkt zu den primären zu rechnen, weil keine Anhaltspunkte für noch fortbestehende Tbc.-Prozesse in den Lungen vorlagen. Im Fall 3 fanden sich gleichfalls keine klinischen Zeichen eines Lungenprozesses. Da keine Röntgenuntersuchung der Lungen ausgeführt worden war, lässt sich nicht sicher entscheiden, ob die Magenveränderungen in diesem Falle primär waren oder nicht. Klinisch dürfte der Fall jedoch, ebenso wie die beiden anderen, in Anbetracht des Fehlens aller Lungensymptome zu den primären zu zählen sein.

Die Symptome waren in den beschriebenen Fällen, wie bei Magentbc. im allgemeinen, sehr wenig charakteristisch. Schmerzen waren bei allen eine zeitlang vor der Aufnahme ins Krankenhaus vorhanden, in Fall 1 unmittelbar vor den Mahlzeiten, in Fall 3 von tardivem, in Fall 2 von diffusem Typus. Das unmittelbare Auftreten von Schmerzen nach der Mahlzeit im Fall 1 hängt wahrscheinlich mit der Lokalisation des Prozesses im Korpus zusammen. Erbrechen wies Fall 2 auf, während sowohl Fall 1 wie Fall 3 nur saures Aufstossen hatten. Dies ist durch die Lokalisation und das Aussehen der Tumoren vollauf erklärt. Im Falle 1 war der Prozess im Korpus lokalisiert und hatte vorläufig nur eine relative Stenose hervorgerufen, in Fall 3 war des erbsengrosse Tuberkulom in der präpylorischen Region zu klein, um eine Pylorusstenose zu verursachen. In Fall 2 dagegen war durch die relativ grosse Kanalisinfiltration eine beginnende Pylorusstenose zustandegekommen, die vielleicht durch die Kompression von seiten der grossen mesenterialen Adenopathien verschärft wurde. Die bei Magentuberkulose häufig vorkommende Anazidität bestand auch in Fall 1 und 2. In Fall 3 ist nicht vermerkt, ob ein Probefrühstück gegeben worden war. Auffallenderweise fehlten in allen drei Fällen die von RICARD und CHEVRIER als charakteristisch beschriebenen Diarrhöen.

Fall 2 und 3 waren in typischer Weise in der präpylorischen Region lokalisiert, ein Fall, 1, ebenso wie gewisse von BIERNATH, GEUKEN und GIARDINA beschriebene Fälle, im Korpus.

Von dem in ZESAS Zusammenstellung gefundenen Verhalten, dass die Magentuberkulose am häufigsten im Alter zwischen 14 und 28 Jahren aufträte, weichen meine drei Fälle insofern ab, als sie bedeutend älter waren. Der jüngste Patient war 43, der älteste 69 Jahre alt. Zwei waren männlichen, einer weiblichen Geschlechtes.

In den Fällen 1 und 3 wurde die Resektion mit einem bisher guten Resultat ausgeführt. Fall 3 ist nach 3 ½-jähriger Beobachtungszeit noch symptomfrei. In Fall 2 wurde der Tumor bei der Operation für inoperabel gehalten, weshalb man eine GE vornahm. Auch in diesem Falle trat

eine Besserung des Zustandes ein. Die Beobachtungszeit beträgt hier jedoch nur einige Monate.

Beim Studium der in der Literatur beschriebenen Fälle wirkt es erstaunlich, wie relativ selten eine *Röntgenuntersuchung* des Magens gemacht wurde, und wie wenig Aufmerksamkeit man den Röntgenbildern widmete. ROTHER fand in einem Fall von primärer Magentuberkulose bei Röntgenuntersuchung eine schmale unregelmässig begrenzte Brücke zwischen Canalis und Bulbus duodeni. BAETZNER beobachtete eine 8 cm lange unregelmässige Einziehung auf der Majorseite mit unscharfer Kontur der Wand. Nach Resektion sah man, dass die röntgenologisch nachgewiesenen Veränderungen durch ein handflächengrosses, eigentlich nur die Schleimhaut affizierendes Tbc.-Geschwür an der grossen Kurvatur verursacht war. In einem Fall von SCHNEIDER wurde bei einer Fornix-Tuberkulose ausser einer Hypertonie des Magens nichts Bemerkenswertes beobachtet. Nach der Beschreibung von ORSÓS war bei seinem Fall von primärer Magentuberkulose die Magenwand nächst dem Pylorus in eine starre, verengte, zick-zackförmig verlaufende Röhre ohne Peristaltik verwandelt. Im Falle SCHLESINGERS fand HAUDEK einen längs- und quergedehnten Magen, der die Mittellinie rechts handbreit überschritt und noch nach 7 Stunden trotz oftmaliger tiefer Peristaltik mehr als die Hälfte der Kontrastmahlzeit enthielt. Da der Magen reichlich Nahrungsreste enthielt, die eine Sedimentierung von Bi verursachten, waren die kleine Kurvatur und der Pylorus nicht deutlich zu differentiieren. BIERNATH hatte einen Sanduhrmagen mit starker Stenosierung in unteren Drittel der Curv. minor nachgewiesen. Bei Resektion stiess man an der Minorseite auf ein Mark-grosses Tbc.-Geschwür mit wulstigen Rändern. GEUKEN fand bei der Röntgenuntersuchung einen Sanduhrmagen, dessen zwei Säcke durch einen schmalen Kanal im Korpus miteinander verbunden waren. GIARDINA beobachtete gleichfalls einen Sanduhrmagen und ausserdem eine Unregelmässigkeit längs der kleinen Kurvatur. In einigen anderen Fällen wurde die röntgenologische Diagnose auf Pylorusstenose gestellt (DEMEL, SPENGLER, HÖFER u. a.).

Da Röntgenbilder von den in der Literatur beschriebenen Fällen nur ganz ausnahmsweise reproduziert sind, ist es bisher schwer, Erfahrungen über das Aussehen der röntgenologischen Details bei Magentuberkulose zu sammeln. Die Verfasser scheinen im allgemeinen der Ansicht zu sein, dass das Röntgenbild sehr wenig charakteristisch ist und keine Detaildiagnose gestattet.

Von den in meiner Kasuistik vorkommenden Fällen weist indes *Fall 1* ein eigenartiges Bild auf (siehe Fig. 1 und 2), das weder einem Karzinom noch einem Ulcus simplex gleicht und Verdacht auf eine Infiltration ungewöhnlicherer Art erweckt. Die manschettenförmige Infiltration im unteren Teile des Korpus zeigt auffallend gleichmässige und runde Kon-

turen. Ebenso wird bei Kompression ein eigentümliches Schleimhautrelief mit rundlichen gleichmässigen Verdünnungen sichtbar, die sich in ihrer Art von den gewöhnlichen, durch Karzinom hervorgerufenen Defekten mit deren meist ungleichmässiger und eckiger Begrenzung unterscheiden. Ausserdem hat ein Karzinom selten die Wachstumsform eines regionären konzentrischen Tumors im Korpus. Man bekommt bei der Röntgenuntersuchung den Eindruck einer ödematösen Infiltration mit multiplen Schleimhautdefekten. Aus diesem Grunde wurde bei der Röntgenuntersuchung ein Karzinom oder ein Ulcus simplex für unwahrscheinlich gehalten, und die Diagnose auf eine Infiltration von unklarer Ätiologie gestellt. *Fall 2* zeigt ein weniger charakteristisches Bild (Fig. 3). Die Infiltration im Kanalis zeigt hier nichts, was von einem Ulkustumor oder einem Szirrhus abweichen würde. In *Fall 3* (Fig. 4) waren die Veränderungen zu klein, um sich auf den Röntgenbildern charakteristisch zu manifestieren. Man sieht hier einen unregelmässigen, kleineren präpylorischen Defekt, der wahrscheinlich teilweise dem erbsengrossen Tuberkulom entspricht; zum grössten Teil ist die Veränderungen sicherlich durch die angeschwellte, verdickte Schleimhaut bedingt.

Die Röntgendiagnose der Magentuberkulose dürfte also grosse Schwierigkeiten bieten. In Anbetracht des seltenen Vorkommens von Magentuberkulose dürften die einzelnen Radiologen auch zu keiner grösseren Erfahrung über die Röntgenbilder bei diesen Zuständen kommen. Es erscheint mir jedoch nicht unmöglich, dass man mit vermehrten Kenntnissen über das Röntgenbild des Schleimhautreliefs bei verschiedenen pathologischen Zuständen in gewissen Fällen wenigstens eine Wahrscheinlichkeitsdiagnose stellen können wird.

ZUSAMMENFASSUNG

Die Magentuberkulose ist trotz des reichlichen Vorkommens von Lungen- und Darmtuberkulose ein sehr seltenes Leiden. Die lokale Tuberkulose im Magen ist entweder von ulzerösem oder hypertrophischem Typus. Dazu käme eine von Poncet beschriebene akute, entzündliche Form. Die Lokalisation im Canalis ventriculi ist am häufigsten. Komplikationen in Form von Blutungen, Perforationen etc. sind selten. Die Symptomatologie ist nicht charakteristisch, die Prognose ernst. Verf. hat drei Fälle von klinisch primärer Magentuberkulose beobachtet. In zwei von den Fällen fanden sich jedoch bei der Röntgenuntersuchung alte ausgeheilte Lungenherde. In einem Fall war der Prozess im Korpus, bei den beiden anderen im Kanalis lokalisiert. Zwei Fälle wurden mikroskopisch verifiziert, beim dritten wurde eine Mesenterialdrüse nachgewiesen. Die Symptome waren nicht charakteristisch. In zwei Fällen wurde Resektion gemacht, im dritten G-E. Ein Fall ist durch $3^1/_2$ Jahre beobachtet, die anderen durch einige Monate. Von allen drei Fällen finden sich Röntgenbilder; im Falle 1 wies es ein eigenartiges Aussehen auf, das Verdacht auf eine Infiltration von ungewöhnlicher Ätiologie erweckte.

SUMMARY

Though pulmonary tuberculosis and tuberculosis of the intestine are of very frequent occurrence, tuberculosis of the stomach is a very rare disease. Local tuberculosis of the stomach is either of the ulcerous or the hypertrophic type; and besides these there is said to exist an acute, inflammatory form, described by Poncet. The localisation in the canalis ventriculi is the most frequent one. Complications in the form of hemorrhages, perforations, etc., are rare. The symptomatology is not characteristic; the prognosis is serious. The author has observed three cases of clinically primary tuberculosis of the stomach. In two of them the roentgen examination disclosed old, completely healed pulmonary foci, however. In one case, the process was localised to the body of the stomach; in both the others to the canalis ventriculi. Two of the cases were verified by microscopy; in the third, a mesenteric gland was found. The symptoms had nothing characteristic. In two of the cases resection was made; in the third gastroenterotomy. One of the cases has been under observation for two and a half years, the others for some months. Roentgenographs exist of them all; that of Case I presented a peculiar appearance which aroused suspicion of some infiltration of unusual etiology.

RÉSUMÉ

Malgré la grande fréquence de la tuberculose pulmonaire et intestinale, la tuberculose gastrique est une affection fort rare. La tuberculose locale de l'estomac appartient, soit au type ulcéreux, soit au type hypertrophique. A ces deux formes, il y aurait lieu d'ajouter une forme inflammatoire aiguë, décrite par Poncet. La localisation de l'affection au canalis ventriculi est la plus fréquente. Les complications, sous forme d'hémorragies, de perforations, etc., sont rares. La symptomatologie n'offre rien de caractéristique et le pronostic est sérieux. L'auteur a observé trois cas de tuberculose gastrique cliniquement primitive. Dans deux des cas, l'examen radiologique permit cependant de constater la présence de foyers pulmonaires anciens et guéris. Le processus était localisé au corps de l'estomac dans un cas, et au canalis dans les deux autres. Deux des cas furent vérifiés par l'examen microscopique; dans le troisième on trouva un ganglion mésentérique. Les symptômes n'avaient rien de caractéristique. Dans deux cas, on recourut à la résection, et dans le troisième, G-E. Un des cas fut suivi pendant 2 ans et demi, les autres pendant quelques mois. Il existe des radiographies des trois malades. Dans l'observation 1, on constata un tableau assez particulier, faisant penser à une infiltration d'origine inaccoutumée.

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Fig. 1.

Fig. 3.

Fig. 2.

Fig. 4.

FROM THE PHYSICAL LABORATY OF RADIUMHEMMET, STOCKHOLM
(CHIEF: R. M. SIEVERT)

THE METHODS FOR TESTING RADIUM PREPARATIONS USED BY THE PHYSICAL LABORATORY OF RADIUMHEMMET, STOCKHOLM

by

Rolf M. Sievert

Among the duties of the Physical Laboratory of Radiumhemmet is that of a central institute for the examination of radioactive preparations of the kind used in Swedish medical radiology, i. e. emitting γ-rays corresponding to those of radium of at least 0.1 mgr. In the autumn of 1929, when the Laboratory moved into new, fairly spacious premises, permanent apparatus for such examinations could be installed. As the design of the instruments and the methods used in several respects differ from those ordinarily used, a short description may be of interest.

Preparations sent in to the Laboratory for examination are examined

1) to make sure that the container is well sealed (radium emanation);

2) to determine the quantity of radioactive substance;

3) to ascertain what radioactive substances are enclosed in the preparation.

The tests are made in the order in which they are here enumerated.

When received, the sample is immediately placed in a fan-exhausted cabinet, so that, in case of leakage, no emanations will penetrate into the Laboratory. Before acceptance, the outside of the preparation must be well cleaned, so that no radioactive substance may conceivably adhere to it. If the sample is a newly filled container which has not yet been used, this risk may be fairly large. In several cases radium examinations have had to be discontinued for many days because emanation leakage had caused an active deposit on the measuring instruments. If the preparation is definitely known to be leaking, it is hermetically enclosed in a suitable glass container.

As soon as possible it is examined for emanation by means of a simple testing device of the kind shown in fig. 1. This apparatus is mounted in the cabinet mentioned above. Several preparations may of course be tested simultaneously, as it is only a question of establishing whether there is any leakage or not. The sample or samples are placed in a glass tube which is evacuated by means of a water pump. As soon as a fairly good vacuum has been obtained, the taps on either side of the glass tube are closed and the samples left in vacuum for about half an hour. Air is then let in, and by means of a rubber ball the air in the tube is pressed into an ionization chamber, the outer walls of which are charged to about 100 volt. The central electrode of this chamber is connected to a sensitive ISING string-electrometer, which reacts distinctly to very small traces of emanation. The glass tube with samples should of course be removed while the actual observations are taken. To be able to work independently of the sensitivity of the electrometer, another ionization chamber is also provided, containing uranium oxide. A constant ionizing intensity is thus always available for comparisons.

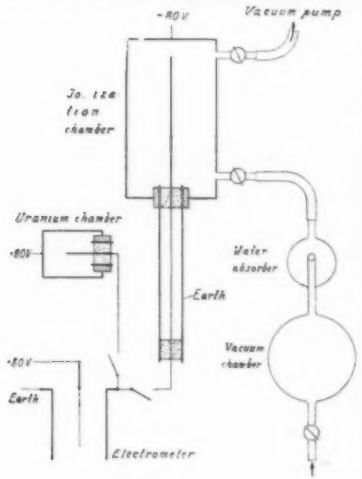


Fig. 1.

Samples showing emanation leakage are immediately hermetically sealed by enclosure in glass containers. When cleaning the exterior of a sample, as mentioned above, a rather important matter should be remembered, viz. that if fluids are used for washing, these should be thoroughly evaporated before the examination for leakage. Otherwise, any 0.003 mm or smaller pores in the container walls will be filled with fluid by capillary action, and remain effectively sealed even if complete vacuum is established outside the container.

The quantitative determination of the activity of the sample is done by the γ-ray method. Experiments with both string electrometers and gold leaf electroscopes have resulted in the latter being selected, which are used with ordinary timing. The drawback of a gold leaf electroscope, however, is the difficulty to obtain a leaf which will move absolutely evenly during the discharge. Partly to reduce the time required for the measurements, but principally to eliminate sources of error in the instruments, a method with two electroscopes has been chosen (see fig. 2). Although no faults can be discovered either in the insulating

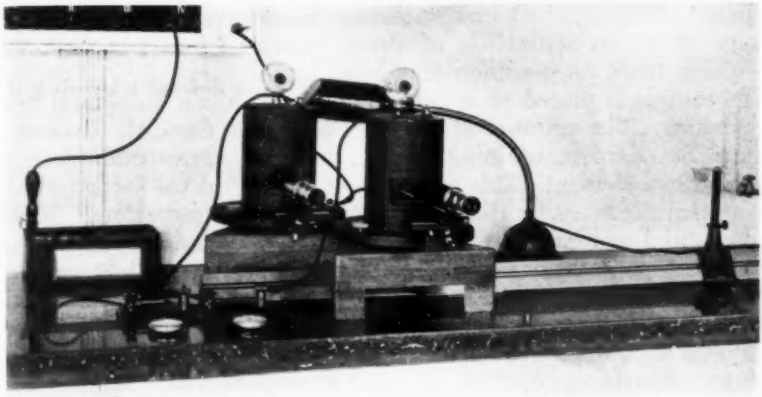


Fig. 2.

material or in the gold leaves, it does sometimes happen that one of the instruments suddenly gives results differing from those of the other instrument by as much as 1 per cent. When the gold leaves are renewed, this difference disappears. Similar faults in the gold leaves may of course occur at any time during a series of measurements, and under unfavourable circumstances they might remain undiscovered if two instruments are not used simultaneously. Considerable assurance is thus gained by using two instruments.

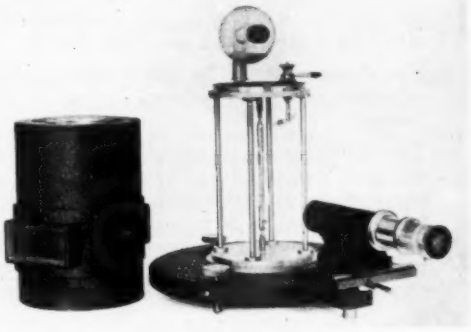


Fig. 3.

The design of the instruments is to be seen from fig. 3. The gold leaf is fixed on a rod pointed at the upper end and with two points at the bottom end. This rod is inserted between two amber cups, which gives a very small contact surface, and the leakage through the insulators is consequently very considerably reduced.[1] The electroscopes are wholly of zinc, of 1 cm wall-thickness. As zinc has proved to be a material with very small natural radiation effect[2], the spontaneous natural discharge will be in-

[1] cf. W. Bothe, ZS. f. Physik, 24, p. 10, 1924.

[2] K. Molin, Experimentelle Untersuchungen über Intensitätsverhältnisse in der M-Reihe von Röntgenspektren, Uppsala 1927.

significant. With one instrument, leakage times have been obtained which correspond to an ionization of about barely 25 ions per second and cm^3, which must be considered as very satisfactory.

The sample is placed on a carriage movable along an optical bench, 150 cm long. The primary standard used is the Swedish Government Radium Standard, containing radium bromide corresponding to 7.36 mgr of radium element. This preparation is No. 7 of the secondary standard preparations calibrated in 1913 by the International Radium Standard, and examined by CURIE, RUTHERFORD, and MEYER. Some of the medical preparations of the Radiumhemmet, accurately calibrated by the Government Standard, are also used as secondary standards.

There is a lamentable lack of information regarding the manner in which activity of the kind mentioned here is usually determined in Institutes exercising control of radium preparations. As the use of radium has increased in recent years to such an extent that even a nonphysicist must understand the more simple methods of measuring, we feel justified in giving here the regulations in force at the Physical Laboratory of the Radiumhemmet for taking measurements.

Regulations for determining radioactivity by the gamma-ray method with two gold leaf electroscopes

1. The stop-watches are started simultaneously and allowed to run for about 10 minutes, when they are simultaneously stopped. The results must not differ by more than 1 sec. at the most.
2. The charge should be about 300 volt. Before each series of measurements, some ten rapid charges and discharges should be made to »ease up» the gold leaves.
3. The ocular scale is sharply focussed before the microscope is adjusted on the gold leaf and turned to about right angles to the gold leaf. The microscope is set so that satisfactory readings may be taken when the gold leaf is at the 20.0 and 80.0 marks on the scale. When fully charged, the edge of the gold leaf should be between the 10.0 and 15.0 marks. The time is taken between the 20.0 and 80.0 marks. Readings must always be taken to within $^1/_5$ sec. The gold leaf must on no account »jerk» or oscillate during discharge.
4. When the preparations compared differ in activity by more than 20 per cent, the leakage time is taken between the above mentioned scale divisions. If the difference is less, the leakage time is observed between the 40.0 and 60.0 scale divisions, and multiplied by 3. Readings must always be taken to within 5 sec. The leakage time must not be less than 5,000 sec.
5. The strongest sample of the series to be measured is placed on the carriage and adjusted at such a distance that the time of discharge, by the instrument giving the shortest time, will be about 120 sec.
6. Cylindrical preparations are measured at right angles to their long axes, and half the readings are taken after turning the preparation 180° round this axis.

7. A series of readings are taken according to the following table:

	Instrument I	Instrument II	Scale divisions
Temperature and atm. pressure are observed.			
Leakage	1 observ.	1 observ.	20—80 (40—60)
Standard prepar.	4 »	4 »	»
Prepar. turned 180°			
Standard prep.	2 »	2 »	»
Sample 1	2 »	2 »	»
Sample turned 180°			
Sample 1	2 »	2 »	»
Standard prep.	2 »	2 »	»
Sample turned 180°			
Standard prep.	2 »	2 »	»
Sample 2	2 »	2 »	»
—			
—			
—			
Standard prep.	2 »	2 »	»
Prepar. turned 180°			
Standard prep.	4 »	4 »	»
Leakage	1 »	1 »	20—80 (40—60)

Temperature and pressure are observed.
All times are given in seconds.
If the room temperature varies much, temperature readings should be taken every hour.

8. If the average times of two readings on the standard preparation between which a sample has been tested differ by more than 0.5 per cent, the sample must be re-tested.

9. The difference between the times obtained for a particular sample and electroscope must not exceed 1 per cent if the sample has not been moved.

10. *A preparation suspected of leakage, from which emanations may conceivably be emitted, must immediately be placed in the ventilation cabinet, and the fan set going.* There, the preparation should as soon as possible be enclosed in a glass tube the end of which should be melted and so closed, or placed in a glass jar whose stopper should be effectually sealed by paraffin.

11. *When the work is finished, all radium must be locked up in the safe.* Failing other instructions, the key should be handed to the Head of the Laboratory personally.

The values obtained in this manner are so good that the mean error of the activity investigated in series of measurements made according to the above table will be less than ± 0.2 per cent, and may consequently be entirely disregarded.

By far the largest sources of error in measuring radioactive substances lie in the corrections for absorption of the γ-rays in the walls of the sample and in the radioactive substance itself. Whenever possible, the absorption is determined by placing the preparations one be-

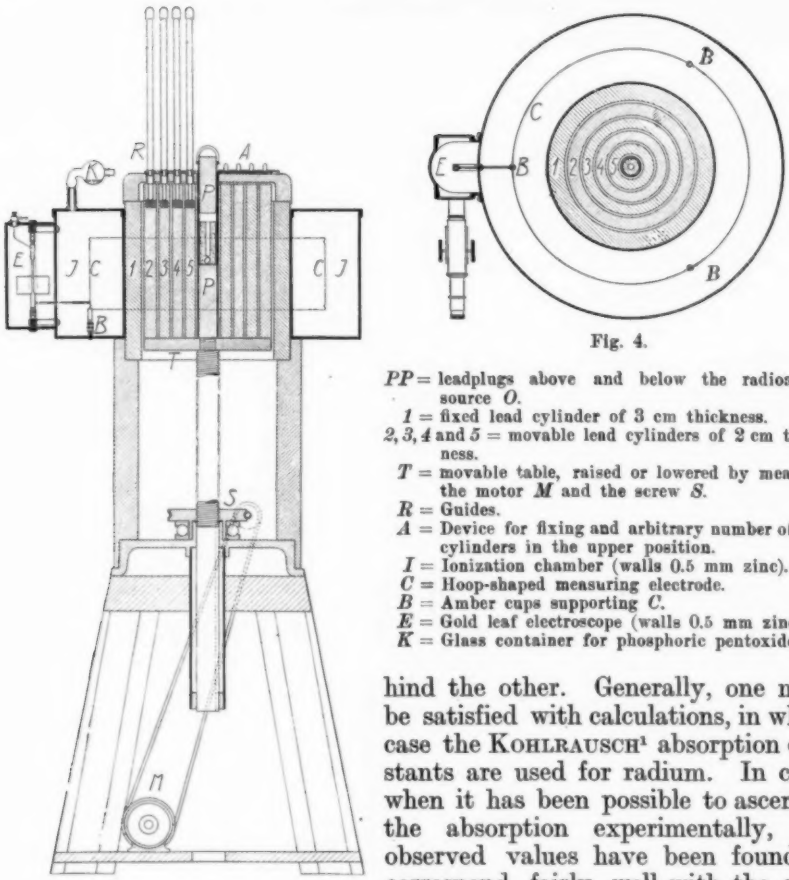


Fig. 4.

PP = leadplugs above and below the radioactive source *O*.
1 = fixed lead cylinder of 3 cm thickness.
2, 3, 4 and *5* = movable lead cylinders of 2 cm thickness.
T = movable table, raised or lowered by means of the motor *M* and the screw *S*.
R = Guides.
A = Device for fixing and arbitrary number of lead cylinders in the upper position.
I = Ionization chamber (walls 0.5 mm zinc).
C = Hoop-shaped measuring electrode.
B = Amber cups supporting *C*.
E = Gold leaf electroscope (walls 0.5 mm zinc).
K = Glass container for phosphoric pentoxide.

hind the other. Generally, one must be satisfied with calculations, in which case the KOHLRAUSCH[1] absorption constants are used for radium. In cases when it has been possible to ascertain the absorption experimentally, the observed values have been found to correspond fairly well with the computed values. Only when the correction for absorption is relatively small (not exceeding 4—5 per cent), the amount of radium can be considered correctly determined to within $\pm 1/2 - 1$ per cent.

Finally, as regards the investigation of the γ-ray emitting substances in the sample, this should preferably be carried out without opening the container. The only method of this kind permitting a fairly accurate determination is the one given by BOTHE.[2] A modified type of the BOTHE apparatus, shown in figs 4 and 5, has been designed. The radio-

[1] K. W. F. KOHLRAUSCH, Jahrb. d. Radioakt. u. Elektronik 15, p. 64, 1918.
[2] W. BOTHE, ZS. f. Physik, 24, p. 10, 1924.

active preparation is inserted in a wooden holder in the centre of a large ring-shaped ionization chamber which on the inside is provided with a fixed lead cylinder of 3 cm thickness. The γ-rays from the preparation may be further screened off by 4 lead cylinders, each of 2 cm thickness, raised or lowered as required and lockable at their upper positions. Raising and lowering is done by a motor. The ionization chamber and the electroscope are made of zinc, for the reasons stated above. The electrode in the chamber is a strip of zinc, resting on three points in amber cups.

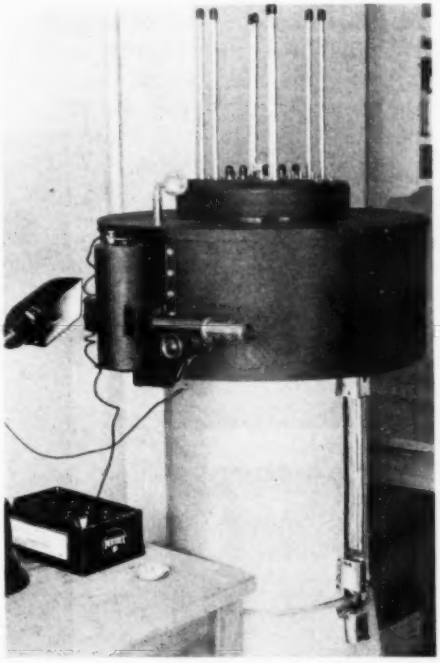


Fig. 5.

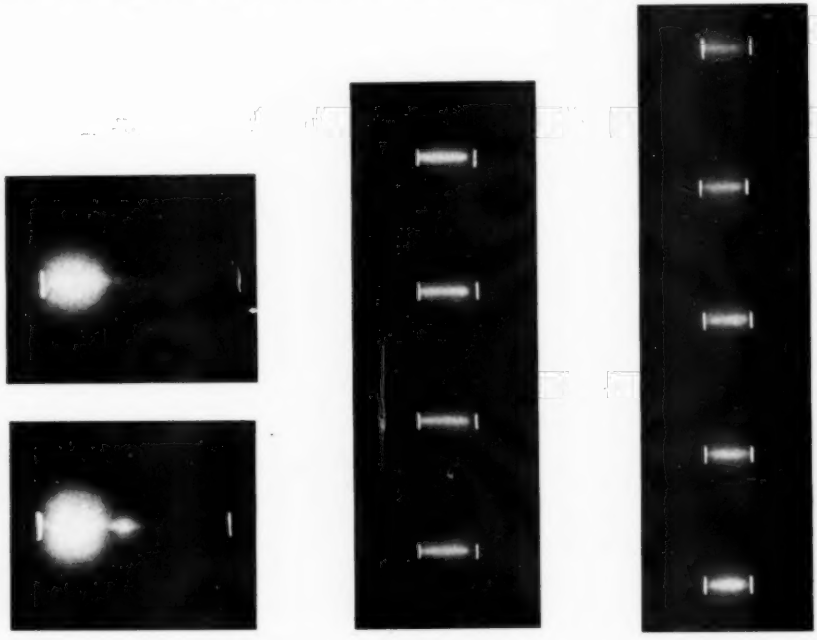
A sample is examined by measuring alternately the rays emitted by a standard preparation and by the sample, with 0, 1, 2, 3, and 4 cylinders respectively in the top position. The proportion between the values received from the standard preparation and from the sample is divided by the same proportion obtained without any lead cylinder in the upper position i. e. only screened by the fixed 3 cm cylinder, and the results are plotted against the thicknesses of the lead screens 5, 7, 9, and 11 cm respectively. Varying kinds of curves are thus obtained with the assistance of which the γ-radiating substances, present in the sample may be identified.

By this method a mesothorium quantity, for inst., of down to a few per cent in a radium preparation may be observed, provided that the approximate age of the preparation is known and that this does not come within a critical range.

In the next article the results of these investigations will be more thoroughly discussed.

If the radioactive substances of the preparation to be examined are not yet in equilibrium, determinations of activity are made at different times.

When the distribution in the preparation of the radium salt is of importance in the medical use of the preparation, this will be examined photographically. The preparation is fixed in some appropriate way as closely as possible to the photographic plate or film, in most cases with only a thin paper between the preparation and the film. The times of exposure are chosen, on the one hand so short that only the



a. *b.* *c.*

Fig. 6.

a. Tubes not satisfactorily filled.
b. Well filled radium cells (0.2 mm platinum).
c. Well filled needles.
The marks show length of cavity.

portions of the plate exposed to the most intense radiation will develop, and on the other hand so that smaller intensities also will cause blackening. In this manner (cf. GUEBEN,[1] RUSS[2]) the distribution of the radium quantity present in the preparation will generally be quite distinctly shown. Fig. 6 shows some exposures of radium tubes and radium needles.

[1] G. GUÉBEN, Acta Radiol., 11, p. 237, 1930.
[2] F. RUSS & D. F. CLEPHAN, Lancet, 219, p. 286, 1930.

When a sample has been examined as here described, a certificate will be issued by the Physical Laboratory of Radiumhemmet. This certificate gives a short description of the preparation, its external dimensions to within 0.01 mm, its weight to within 0.2 mgr, and any other distinguishing characteristics. The name of the person or institute which handed in the sample for examination is also noted, and the time when it was handed in and when it was returned. Finally, the methods employed for the examination are stated, and the γ-activity of the preparation expressed in milligramme of radium element.

SUMMARY

The article contains a description of instruments and methods in use at the Physical Laboratory of Radiumhemmet for testing radioactive preparations of greater activity than 0.1 mgr radium element. Three principal tests are made for this purpose at the Laboratory, viz. for detecting any emanation leakage present, for determining the amount of γ-activity possessed by the preparation, measured in mgr of radium element, and for ascertaining what radioactive substances are present in the preparation. Special instruments have been designed for these tests, and have proved effective. Radiumhemmet issues certificates on the basis of the results obtained by the tests.

ZUSAMMENFASSUNG

Der Aufsatz beschreibt die Instrumente und Methoden, die am Physikalischen Laboratorium des »Radiumhemmet» zur Kontrolle von radioaktiven Präparaten, deren Aktivität über 0.1 mgr Radiumelement ist, benutzt werden. Die zu diesem Zweck ausgeführten Untersuchungen sind in der Hauptsache drei, nämlich: 1) Feststellen, ob die Kapsel emanationsdicht ist, 2) Grösse der γ-Aktivität des Präparates, in mgr Radiumelement gemessen, 3) welche radioaktive Stoffe sich im Präparat befinden. Hierzu sind besondere Instrumente, die sich als sehr zweckmässig erwiesen haben, konstruiert worden. Das Physikalische Laboratorium stellt auf Grund solcher Untersuchungen Prüfungsscheine aus.

RÉSUMÉ

L'article décrit les instruments et méthodes d'étalonnage utilisées au laboratoire de physique du »Radiumhemmet» pour les préparations radio-actives de puissance supérieure à 0.1 mmgr de radium. Les recherches effectuées à cet effet se rangent sous trois catégories: 1°) établissement de l'étanchéité de la capsule; 2°) valeur de l'activité *gamma* de la préparation, mesurée en mmgr d'élément-radium; 3°) détermination des substances radioactives existant dans les préparations. A cet effet, il a été construit un certain nombre d'instruments qui ont été reconnus comme effectifs. S'appuyant sur des recherches de cette nature, le laboratoire de physique délivre des certificats d'essais.

P. M. Hickey.

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In Memoriam

Dr. PRESTON M. HICKEY, professor of roentgenology at the Michigan State University in Ann Arbor, finished his active and useful life on October 30th, 1930. In him America has lost one of her most prominent

roentgenologists, and medical radiology on the whole an energetic and talented pioneer and a singularly representative personality.

HICKEY was born in the year 1865, in the small town of Ypsilanti, near Detroit. His father, one of the first missionaries amongst the Indians in Michigan, bequeathed to him the spirit of a pioneer. His school-years HICKEY spent in Detroit and there he also continued his university studies, taking his degree of M. D. in 1892. After that he studied surgery, specializing in rhinology and laryngology, and soon became attached to his University, the Medical School of Detroit, as professor of pathology. In this capacity he became specially renowned for his technical skill in microphotography, and developed, inter alia, a method of his own in using in his teaching microscopical original sections instead of coloured slides.

Already in his days as assistant HICKEY was attracted by Roentgen's great discovery, and together with his teacher SHURLY he bought one of the first Roentgen apparatuses in Michigan. The new science soon captivated him with its charm, and thanks to his uncommon energy, his great and many talents, and his genius for organisation he became already at an early date one of the leading personalities in his line.

There are chiefly two sides of HICKEY's work that have been of remarkable importance for the development and progress of roentgenology in the United States, viz. firstly his work at the organisation of the American Roentgen Ray Society and as editor of its journal, and secondly his zeal for university teaching of radiology.

The first condition for the development of radiology into an authorized and scientifically equipped branch of medicine HICKEY recognized in a strong and respected union of its disciples. As one of the founders of the American Roentgen Ray Society and its foremost force in holding it together in its early years he is entitled to its permanent gratitude. Characteristic of HICKEY's deep ethical views of his science and its obligatory position, is the address with which in 1907 he resigned his position as president of this society. He emphasizes here the society's duty in combatting quackery and irresponsibility in its own ranks, to elevate its reputation by attaching to itself all conscientious and skilful colleagues, to advance research and technical development in the sphere of roentgenology, furthermore to draw up reliable statistics of the results of radiotherapy as well as satisfactory protective measures for the roentgen staff employed. Ultimately he exhorts the society to use every endeavour to bring about instruction in roentgenology at the universities and disseminate a knowledge of its importance amongst the general public. The character of the speech depicts the man.

For a development towards the goal thus set out the American Roentgen Ray Society required, however, first of all an organ, a regularly

published journal, and it was HICKEY who brought it into existence. As editor, first of the American Quarterly of Roentgenology, afterwards of its successor the American Journal of Roentgenology, HICKEY laboured indefatigably for not less than 10 years on the improvement and progress of this journal, and when, in 1917, he resigned his editorial position, he left it with an established reputation as one of the most prominent roentgenological journals in the world.

Already at an early date HICKEY grasped the enormous importance of well organised instruction in radiology and neglected no opportunity in speech and writing to work for this favourite idea of his. In his later years he also acquired a position which enabled him to carry it into effect on a large scale, inasmuch as in 1922, after the death of Zwaluwenburg, he was installed as professor of roentgenology at Ann Arbor. For eight years he was able to carry out here the work which thanks to his rare gifts for this calling has become of the utmost importance.

HICKEY's program for university training in medical radiology is clearly obvious from his works on this subject, such as they have been rendered in Radiology 1924 and 1927, as well as in Acta Radiologica, Suppl. IV. He points out here the advantages and benefits of instruction in roentgenology at *all* stages of medical training, first in anatomy (bone structure, joints) and physiology (respiratory movements, cardiac pulsations, digestive process), furthermore in pathology (the study of morbid differences in density of various tissues), as well as pharmacology (the action of different drugs on organic function). He considered that the Roentgen light ought to form part and parcel of the students' daily auxiliary methods so that already at this early stage they might become familiar with the technique of its use.

As regards the *position* of roentgenology in medical training HICKEY strongly emphasizes that the teacher of this subject shall be of professorial rank and be considered on an equal footing with the heads of the other great branches of medicine, and that the instruction of the students should be provided through him and not split up amongst teachers in various disciplines without roentgenological expertness.

He further considers that roentgenological tuition at the clinical stage should preferably make use of projected original radiographs and not of slides. It is of the utmost importance that the students are given an opportunity to check the correlation between the radiograph and the clinical findings. Instruction in roentgen diagnostics should be extended not only within the scope of surgery and internal medicine, but it should also embrace other special branches, otology. ophthalmology, obstetrics.

As to the training of future roentgenologists, HICKEY held the same universal views. For this profession he wants men with analytical gifts

and good judgement, as well as wide preliminary studies of the main branches of medicine. The special training should also include roentgen anatomy and roentgen embryology, studies of injected and contrast-filled organs, radiophysics, photographical technique, etc. To the special roentgen diagnostics, which is the essential subject of the training, should furthermore inter alia be added the practice of drawing up roentgenological records with proper physiological and pathological terminology. In summing up the head lines of HICKEY's opinions as to education in roentgenology, I could do no better than quote his own words which might be considered as classical in this scope: »The student should be impressed with the fact that while he has need to be a master of technic, he is not a technician; that when he is requested to examine a case he should familiarize himself with its clinical aspects sufficiently to enable him to decide what examination will be of benefit. He should be encouraged to carry on collateral reading in medicine and surgery so as to be able to discuss with other physicians the modern standpoints of disease. He should be taught to respect his attitude as a consultant and to be able to demonstrate the value and limitations of roentgen examinations in any particular case.»

Numerous works on different branches of roentgenology are the product of HICKEY's pen, mostly published in American journals. He had a special liking for subjects belonging to his old speciality, the diseases of the upper air-passages, respiratory organs and ear. As an author he was never verbose, but his writings as well as his contributions to numerous discussions are distinguished by their extremely clear and concise form, critical conception and an uncommon capacity of rendering the main features in striking expressions. When he dealt with subjects of extensive importance, his rendering bore the impress of broad views, profound experience and wise judgement. It is quite natural that such qualities would also to a high degree characterize the visible monuments of HICKEY's creative faculty, which the expert admires in his private Roentgen Institute at Detroit and in the new Roentgen Institution of the Michigan University Hospital planned by him.

HICKEY's remarkable services rendered to the roentgenology of his native country procured him the unanimous and unstinted gratitude, veneration and affection of his colleagues. On retiring from the editorship of the American Journal of Roentgenology he also became the subject of public homage in the most cordial form both on the part of the editorial staff and from his numerous friends. Eloquent evidence of his public esteem was his widely known and very significant pet name of »Dad Hickey». By virtue of his position, he was elected delegate to the International Congresses of Radiology in London, 1925, and Stockholm, 1928.

Personally HICKEY was of an unpretending and retiring nature, in his daily intercourse calm and taciturn, but amiable and obliging. Amongst his friends he rejoiced in revealing his personal kindness and placid humour. Upon the stranger he left a profound impression of an uncommonly solid and representative personality. The writer of these lines will not easily forget the hearty kindness with which HICKEY in the course of some memorable summer days at the peaceful Ann Arbor gave his time and his experience to a colleague from across the ocean.

PRESTON M. HICKEY died at the age of 65. He had long been suffering from heart disease, and its symptoms grew during the last few months of his life to such a degree that he was no longer able to travel between his home and the hospital. In order to be able up to the last to manage his beloved Roentgen Institute he then lived at the hospital and literally died in harness. The roentgenologists of Scandinavia, in grateful remembrance of his work, join in respectful homage of his memory.

Lars Edling.